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NUCLEAR POWER

SUPPLEMENTAL SOURCES

China Becomes Major Energy Player

926B0009A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 19 Aug 91 p 1

[Article by reporter Wang Hanlin [3769 5060 2651]: "China Becomes Major Energy Resource Power, Attacks on Key S&T Problems During Seventh 5-Year Plan Displaying Enormous Might"]

[Text] China arranged projects to attack nine key problems in the four main realms of coal, oil, nuclear power, and electric power in its energy resource industry during the Seventh 5-Year Plan. The efforts of more than 10,000 S&T personnel produced nearly 900 scientific research achievements. They not only moved the development of China's energy resource industry into the ranks of the world's main energy resource powers in the but also moved our technology up to advanced world levels.

The focus in attacks on key problems in the coal industry during the Seventh 5-Year Plan was on conversion and combustion technology, coal mine safety technology, and high efficiency coal extraction technology and equipment. The appearance of 274 S&T achievements moved the situation in coal industry production technology up to a new stage. At present, the mechanization capacity for coal extraction in China's unified distribution coal mines has been increased to 65 percent. Among all of China's unified distribution coal mines, 125 mines have now been outfitted with complete computer safety monitoring systems, and all high-gas tunneling workfaces have implemented systematized safety equipment. The application of these achievements has led to coal output of 1.08 billion tons in 1990, first place in the world.

The main achievements in attacking key problems in the petroleum industry during the Seventh 5-Year Plan include seismic exploration technology, for which high-resolution seismic work is the primary indicator. The comprehensive application of this technology has nearly doubled the resolution of seismic exploration and provided the capability of resolving strata 15 to 20 meters thick. A set of drilling technologies for directional wells and well clusters has been widely applied. Their application in Liaohe and other oilfields alone has conserved more than 7,000 mu of land, increased crude oil output by 18 million tons, and saved over 200 million yuan in construction costs. By selecting optimum development programs for 13 new oil deposits, oil pool numerical modeling technology at advanced international levels of the 1980's can increase the amount of crude oil from 4 million tons to 12 million tons, and it can be used for dynamic forecasting in regions and blocks in 30 old oil fields, and so on. New breakthroughs have been made in oil and gas exploration in the Tarim, Shaan-Gan-Ning [Shaanxi-Gansu-Ningxia], and other basins. Projections by geology departments indicate that Tarim Basin has one- seventh of China's total petroleum reserves and one-fourth of our natural gas reserves. Our crude oil output was 138 million tons in 1990, fifth place in the world.

The electric power industry took on three projects to attack key problems during the Seventh 5-Year Plan. Four topics alone involving hydropower project dam building technology have been applied in the Longyang Gorge, Lubuge, Xibeikou, and other hydropower projects, reducing project costs by 328 million yuan. China now has 179 generators larger than 200MW, 18 power plants with an installed generating capacity of more than 1,000MW, and 13 power grids larger than 1,000MW. By the end of 1990, China had 7,117 kilometers of 500 kV power lines, a 2.8-fold increase over 1985.

There were also new developments in China's power grid dispatching and communication automation levels during the Seventh 5-Year Plan. Four large multi-province grids have placed multifunction 32-bit miniature dual-processor controlled computer systems imported from foreign countries into operation and a communications network linking all of China's major grids has taken basic shape. In addition, the electric power industry has begun using nuclear power, solar energy, and wind power to generate electricity.

The nuclear industry S&T project "Uranium Isotope Separation Technology" was divided into three topics and 67 special topics. A total of 105 achievements were made, including 16 major achievements. Research on NC-10 centrifuge technology has major significance for China's active and stable development of nuclear power to adapt to our rapid growth in demand for energy resources. Research on laser-method uranium isotope separation technology has promoted developments in China concerning lasers and certain basic research fields.

S&T Led the Way to Creating Energy Bases

926B0009B Beijing RENMIN RIBAO in Chinese 16 Sep 91 p 3

[Article by reporter Lu Xinning [4151 2450 1337]: "Attacks on Key S&T Problems Found Several Energy Resource Base Areas for China, Raised Geology and Mining Theoretical Levels, Perfected Prospecting Technology Measures"]

[Text] Activities to attack key S&T problems in geological prospecting by nearly 10,000 S&T personnel produced successive breakthroughs in the areas of geological theory and prospecting technology. By relying on these theories and technologies, we have now projected a total of 866 prospective mineralization regions and target zones with comprehensive minerals and expanded or newly discovered 82 large and medium-sized mineral beds in east China and the Xinjiang region with a potential economic value of several 10 billion yuan, thus locating several energy resource reserve base areas for China.

Since the beginning of the 1980's, energy resources have become one of the main factors restricting economic development in China. During the Seventh 5- Year Plan, under the organization and coordination of the State Planning Commission, the former State Economic Commission, the State Science and Technology Commission, the Ministry of Finance, and so on, scientific research personnel from the Ministry of Geology and Mineral Resources, China Petroleum and Natural Gas Corporation, and other units have attacked key S&T problems in geological exploration and pushed China's oil and gas and mineral theoretical levels and prospecting technology up to a new stage and achieved major breakthroughs in natural gas theory and prospecting, and major advances have been made in the realm of marine facies carbonate rock.

These attacks on key S&T problems gave a high degree of attention to natural gas resources, proposed the theory of using the concept of dynamic equilibrium for research on natural gas geology in China, and achieved enormous successes. They systematically summarized the geological conditions and accumulation laws of petroleum and natural gas pools, which enriched the theoretical basis of natural gas geology and provided new understandings and new concepts. Attacks on key problems were closely integrated with exploration and breakthroughs were made. Newly proven natural gas reserves during the Seventh 5-Year Plan totalled 299.39 billion cubic meters, an average yearly increase of 59.9 billion cubic meters, which was 48.7 percent higher than the average yearly rate of growth during the Sixth 5-Year Plan, making this the period of the quickest increase in proven natural gas reserves in China. Innovations in plotting natural gas chromatograms and other prospecting technologies have also attained advanced international levels. Large-scale oil and gas deposits have been found through exploration in China's Chengdu Plain, Changchun, southern Songliao, Ordos Basin, marine areas of the South China Sea and East China Sea, and Tarim Basin, and preliminary confirmations have been obtained. Eight of the 16 medium-sized gas fields larger than 10 billion cubic meters discovered in China up to the end of 1990 were discovered during the Seventh 5-Year Plan. This includes the largest natural gas field found so far on the Chinese mainland in the central part of the Shaan-Gan-Ning [Shaanxi-Gansu-Ningxia] Basin. Exploration of Tarim Basin indicates a large oil and gas field with the greatest prospects. Pinghu oil and gas field has been confirmed in the East China Sea and the conditions are in place for development soon. These reveal the broad prospects for natural gas resources in China.

The realm of marine facies carbonate rock is a world-acknowledged enormous oil and gas realm and about 60 percent of oil and gas was generated in this type of strata. Although this type of strata covers an area equal to one-third of China's total area, proven reserves at present only account for 5 percent of the total. Through attacks on key problems, scientific research personnel suggested making comparisons with continental facies sedimentary strata at Daqing and many other areas. There is enormous potential in this realm that can be exploited and it should be the primary direction for future oil and gas exploration in China. Attacks on key problems during the Seventh 5-Year Plan made 52 high and new technology achievements in marine facies geology research and our technical levels are among the most advanced in the world in "Seismic Exploration in Prohibited Areas in High Mountains", "Three-Dimensional Seismic Exploration", and so on. The application of these new technical achievements in exploration practice has produced outstanding achievements. The first marine facies formed gas deposit was discovered in China in Tarim and its projected resources could be as much as 15 to 18 billion tons. This provides a foundation for achieving a shift from continental facies to marine facies in China's oil and gas exploration. Now, for example, we have discovered industrial oil and gas flows and five oil and gas fields including Yakela and others in Tarim and the long-barren "dead sea" has become a "cornucopia" of oil and gas.

Besides the oil and gas fields, China has also made gratifying achievements in theoretical research and exploration for precious metals and non-ferrous metals resources. Based on China's unique geological structure, scientific research personnel have comprehensively applied theories in multiple fields like geology, geophysics, and geochemistry and utilized 38 new technologies including aerial remote sensing, paleogeomagnetism, spectral excitation, and so on and obtained rich scientific data on the geology of the Xinjiang region and obvious results in the search for minerals in a short period of time. This is uncommon internationally. Even more inspiring are the results of attacks on key problems showing that two of the world's three huge mineralization zones pass through Xinjiang. Xinjiang has broad prospects for gold, lead, copper and other valuable non-ferrous metal resources. This includes Altay, which may rival the Altay mining region in the Soviet Union, which has been called a "non-ferrous metals treasure-house". The area has now been named a "gold, non-ferrous, and rare metals development zone". Exploration and confirmation of Xinjiang's abundant mineral resources has historical significance for alleviating China's serious resource shortages and solving the energy resource shortage problems of heavy industry. During the period of attacking key problems, some of the achievements in the areas of developing applied research were used in production. Examples include 100,000-ton grade heap straining for Sarbulak ore, the largest scale completed in China so far, and the ore dressing plant at Dornasi which can process 100 tons of ore per day, with extremely significant economic benefits.

Attacks on key S&T problems during the Seventh 5-Year Plan did not just lay a foundation for establishing mineral resource reserve base areas. Research and exploration of hidden ore beds in developed areas of East China have also located replacement mineral resources

for mines facing closure in these regions that have alleviated the contradiction of resource shortages in the economically developed regions in the middle and lower reaches of the Chang Jiang.

Enhancing Environmental Protection in Electric Power Industry

92WN0226A Beijing DIANLI JISHU [ELECTRIC POWER] in Chinese Vol 24 No 11, Nov 91 pp 2-7

[Article by Shu Huifen [5289 1920 5358], Safety and Environmental Protection Administration, Ministry of Energy: "Conscientiously Implement the State Council Decision on Further Strengthening Environmental Protection Efforts, Revamp Environmental Protection in the Electric Power Industry"]

[Text] Editorial Note. Environmental protection is a basic national policy and a glorious undertaking that will create wealth for mankind as a whole and for future generations, but is also an arduous task. During the Seventh 5-Year Plan, environmental protection efforts in the electric power industry posted major achievements. In order to implement the State Council decision on further strengthening environmental protection efforts, to analyze environmental protection activities by the electric power industry during the Seventh 5-Year Plan, and to draft power-industry environmental protection programs for the Eighth 5-Year Plan, on 25-27 April 1991 the Ministry of Energy held its "Electric Power Industry Environmental Protection Work Conference" in Beijing. Our column for this month is in keeping with the spirit of this conference, whose objectives were to promote the thorough performance of environmental protection activities in the power industry, to strengthen unified management of flyash removal and boiler ash handling, to reap benefits from the investments embodied in existing environmental protection facilities, to make use of scientific and technical progress in the vigorous investigation and development of new technologies and new products, and to coordinate the management and regulation of energy resources with their integrated utilization so that the development of the power industry is coordinated with environmental protection efforts.

I. Summary of Electric Power Industry Environmental Protection Activities During the Seventh 5-Year Plan

During the Seventh 5-Year Plan, China's power industry developed rapidly. New large- and medium-capacity generating equipment and facilities installed during the 5-year period totaled 39.05 million kW, including 33.13 million kW of fossil-fired generation capacities, or 84.9 percent of the total. In each year the use of coal electric power generation accounted for about one-fourth of the country's total coal consumption; owing to the large amount and low grade of the coal used for the purpose and the fact that power plants are point-source pollutant emitters, the resultant environmental problems are becoming increasingly troublesome. In order to coordinate electric power production and construction activities with environmental protection efforts, we have pursued the environmental policy of "prevention as the primary aim, coordinated prevention and control, and integrated management," and have stepped up environmental management, utilized scientific and technical progress, and worked to control pollution. With the support of the relevant departments of the State Council, the joint efforts of all departments in the electric power field enabled power-industry environmental protection activities to make major progress, producing a major change for the better in environmental conditions.

In 1990, the average flyash removal efficiency of power plants directly subordinate to the power system exceeded the state target of 93 percent for the Seventh 5-Year Plan. The amount of coal used for power generation by plants with capacities of 50,000 kW or more increased by 90 million tons, but particulate emissions increased by only 90,000 tons. The degree of comprehensive utilization of powdered coal ash reached an all-time high of 18.66 million tons, surpassing the target of 10 million tons 3 years ahead of schedule. Some 16,000 mu of full ash dumps have already been covered over with earth, providing experience in the recultivation of ash such sites.

The Seventh 5-Year Plan's emission control targets for acidic and alkaline effluent, oil-contaminated water, and other liquid waste from fossil-fired power plants were met. In 1990, 44 power plants implemented closed ash-removal water cycles, and a total of 180 million tons of ash-removal water was recovered. Over the 5 years, a total of 700 million tons of ash-removal water and industrial wastewater were recovered and re-used, thus conserving water and controlling wastewater discharges; these measures alleviated water pollution and were of major significance to the self-reliant development of the electric power industry and to economic construction in regions that are short of water.

Ten electric power plants, including the Datong No 2 plant, were awarded the title of "Environmentally Superior Plant" or "National Advanced Environmental Protection Enterprise" by the state. At the same time, a large group of power plants entered the ranks of province- and municipal-level advanced environmental protection units. At the 1991 environmental protection conference,the Ministry of Energy and the Hydropower Engineering Society jointly commended 16 advanced units that had made contributions to environmental protection in the power industry, 35 advanced collectives, and 100 advanced individuals.

The main insights from power-industry environmental protection activities during the Seventh 5-Year Plan are as follows:

A. Improving leadership environmental awareness and implementing leadership responsibility for environmental protection at all levels are the key to effective environmental protection efforts.

Environmental protection is a basic state policy in China. The state has issued a series of environmental protection laws and regulations together with the relevant administrative and economic-management measures; in response, leaders at all levels have increased their environmental awareness and their sense of social responsibility for pursuing environmental-protection efforts while increasing output. All local governments have also included environmental protection among their current objectives and have signed environmental protection performance agreements with the provincial or municipal power plant heads. The agreements that some electric-power management administrations and electric-power administrations have signed with power plant directors make environmental protection an important evaluation criterion, and plant directors have also assigned environmental objectives to the individual shops and brigades, so that environmental protection is being implemented at every level and is being conscientiously placed on the agenda at all levels. The top officials of many electric power management administrations and electric power administrations have personally instituted the review of environmental evaluation reports and have incorporated state-assigned management objectives with specific deadlines into administration- and plant-level technical modernization programs.

B. Standardized, systematized management efforts assure the implementation of the "three simultaneous" program.

Controlling new pollution requires effective oversight of the "three-simultaneous" activities. During the Seventh 5-Year Plan, an average of more than 6 million kW of fossil-fired power production equipment went into service every year, and projects representing similar sums were started and were under construction. In accordance with the requirements of environmental protection laws, in order to assure that new fossil-fired power plants or existing plants that are being expanded will comply with local or national emission standards and that no further ground will be lost in environmental protection, we drafted a series of regulations and procedures, geared to the distinctive characteristics of the industry, for each stage of construction, which in combination covered all environmental-protection management activities for the entire course of the construction project. Examples include the "Environmental Protection Management Procedures for the Early Stage of Fossil-Fired Power Plant Construction Projects," the "Regulations for Drafting Summary Environmental Impact Evaluations of Fossil-Fired Power Plant Construction Projects," the "Principles for Drafting Fossil-Fired Power Plant Environmental Impact Statements and Specific Regulations on Their Subject Matter," the "Regulations on Techniques for Meteorological Testing to Determine Pollution Levels Produced by Fossil-Fired Power Plants," the "Regulations on Techniques for Evaluating the Impact of Fossil-Fired Power Plants on the Aquatic Environment," the "Regulations for Environmental-Protection Design of Fossil-Fired Power Plant Construction," and the "Procedures for Acceptance Testing Following Completion of the Environmental Protection Facilities of Fossil-Fired Power Plant Projects." These regulations not only specified the nature of the work to be done, but also clarified the mutual responsibilities of management, design, construction and operation units at all levels and tightened management of the entire environmental-protection process in construction projects.

Over the 5-year plan, environmental-protection evaluations were completed for 119 fossil-fired power plant projects involving investments of 200 million yuan or more and for 45 hydroelectric stations. The environmental impact evaluations were used as a basis for defining acceptable scales of construction and specifying required antipollution measures. For example, in the design of fossil-fired power plant projects, in order to assure environmental protection, much use was made of antipollution technologies suited to domestic conditions. In the last few years, electrostatic precipitators have been used for flyash removal on 80 percent of newly commissioned large fossil-fired generating units, and the use of dry boiler-ash handling techniques has paved the way for greater utilization of powdered coal ash. In wet ash handling techniques, slurry transport technology was used and the extent of external disposal of ash-water mixtures was decreased. Each year, every power generation management administration and electric power administration carried out a "three-simultaneous" review of all projects put into operation in that year, and any problems that were identified were corrected in timely fashion. In 1990, the Ministry of Energy set up six "three-simultaneous" inspection teams to review key projects.

C. Environmental management of power plants must be integrated into power-plant operations management in order to achieve truly coordinated development of power production and environmental protection.

Since the reform and opening to the outside were instituted, the implementation of the management contract responsibility system in electric power production and the setting of up direct linkages between performance and power plant employees' economic benefits have provided a great stimulus for all types of power plant-related activity. Environmental protection is an inseparable part of the safe and enlightened operation of power plants, and as a consequence, production targets handed down to certain plants were accompanied by environmental evaluation targets, and environmental protection language was included in the contract provisions governing the technical modernization of old plants and was incorporated into the evaluation standards for upgrading the status of the enterprises. In connection with the technological modernization of pollution control, for example, in a period of 3 years, funding was provided for more than 900 million yuan worth of environmental protection projects, accounting for more than 50 percent of power plant technological modernization outlays; to this amount was added more than 100 million yuan in supplementary funds and loans made available by the

environmental departments out of revenues from waste disposal fees. A total of more than 300 particulate emissions management projects and more than 100 wastewater management projects were carried out. Closed-cycle boiler ash water-flush systems were implemented at 20 percent of all power plants, which constituted a major advance toward converting wastewater into a usable resource. The disposal of ash in rivers and streams by 12 plants was ended, and a group of power plants rid themselves of the label of "major polluters." Pollution control activities reaped major environmental and economic benefits. For example, Shandong Province invested nearly 20 million yuan in wastewater management projects at several power plants, resulting in a decrease of 17 million tons a year in wastewater discharges and saving 4 million tons a year of fresh water, which yielded major economic benefits.

In 1990, the Ministry of Energy issued the "Evaluation Techniques for the Highest-Level Environmental Protection Rating of Fossil-Fired Power Production Enterprises" and the "Detailed Guidance for Environmental Protection Evaluation of Fossil-Fired Power Generating Enterprises," which made environmental protection a major evaluation criterion in deciding on the upgrading of enterprises and on the attainment of "two-enlightened" objectives, and in addition directly linked power plants' economic benefits and reputations to environmental protection. Enterprise leaders universally treated these matters with the appropriate seriousness, which promoted tighter environmental management and pollution control by power plants and the effective operation and maintenance of existing environmental-protection facilities, thus helping to realize the full benefit of the investments embodied in them.

D. A well-rounded program of scientific investigation provided practical technologies for pollution control.

During the Seventh 5-Year Plan, the electric power industry set up more than 100 environmental research projects. Many of their results have now been disseminated and put into use. New electrostatic precipitators that collect high-resistivity particulates and the flyash from anthracite coal have been implemented; in order to conserve steel, the design of electrostatic precipitator housings has been optimized; and in order to achieve stable, high-efficiency operation and energy conservation, multipurpose power supplies, microcomputer-controlled power supplies and pulsed power supplies for precipitator units have been developed. The pursuit of a well-rounded set of development projects gave results that were highly practicable and which rapidly led to the production of specific products. A project on rotary-spray dry sulfur dioxide removal has already passed state evaluations. New progress has already been made in technologies for the reuse of boiler-ash flush water. A technique for the integrated use of powdered ash from high-ash coal and some economically beneficial energy-saving technologies have been developed.

With the rapid expansion of the electric power industry and the emergence of large power plants and power-plant clusters, there has also been research work on macroscopic topics dealing with the relationship between electric-power programs and environmental capacity. In connection with the drafting of power-production programs, a study entitled "The Changjiang Delta Fossil-Fired Power Program Atmospheric-Environment Forecast," based on an evaluation of more than 30 large and medium-size fossil-fired power plants in East China, forecast the atmospheric environmental impact that the development of coal-fired power generation in this region would be likely to produce by the end of the century and offered suggestions on the electric power program and on rational plant siting. To assure that environmental research projects would quickly lead to production capabilities, we focused on effective coordination of three areas, namely: coordination between applications research and basic research; coordination between technology development and product development; and coordination between the development of technology and its dissemination and application.

E. Strengthen basic work on environmental management and make broad policymaking more scientific.

Environmental monitoring and statistical analysis are basic to environmental management, and in the last 5 years there has been a real intensification of work in these two areas. The electric power industry has set up a three-level environmental network, which includes a central electric power environmental monitoring office, 29 environmental monitoring centers at the provincial power management administration or electric power administration level, and 177 power plant-level environmental monitoring stations. We set up a computerized nationwide power-industry environmental protection statistics system which provides scientific data for ministry-level and administration-level environmental management and for the drafting of pollution control programs.

F. A pool of well qualified personnel is needed for environmental protection activities.

In the course of the environmental protection effort, we have also focused on personnel development. We have already created a pool of specialized environmental personnel with respectable abilities in environmental management, evaluation, design, monitoring, research and teaching. Some 1700 persons in the electric power system are already engaged full-time or part-time in environmental protection work, including more than 500 technical people with the rank of engineer or higher. Environmental engineering specializations at two ministry institutions of higher education have sent more than 200 graduates to environmental protection posts at various levels, where they constitute a new environmental-protection force. In addition, a core group of personnel has been sent abroad for study and training, and they should have an excellent effect after their return.

G. Effective environmental protection work in the power industry requires awareness and support on the part of the environmental protection departments at all levels.

During the Seventh 5-Year Plan, the progress of pollution control in the electric power industry was highly dependent on the support of environmental protection departments at all levels. The state environmental protection administration listened to industry views in many of its major policy decisions and was effective in implementing vertical and horizontal coordination, so that the policies and standards that it issued both stimulated the power industry and made allowance for its economic condition. The electric power administrations are the departments to which the power plants are subordinate, but also are the power industry's economic accounting units and the bodies that allocate the power plants' technological modernization funds each year. The environmental protection administrations of ten provinces have now taken cognizance of this characteristic of the power industry and are granting or lending money out of revenues from pollutant disposal fees to the electric power offices, which combine this money with the regular technical modernization funds in order to solve certain pressing environmental problems. Experience indicates that this approach is consistent with the actual circumstances of the power industry and gets the maximum benefit out of limited funding.

II. The Electric Power Industry Environmental Protection Activities Plan for the Eighth 5-Year Plan

During the Eighth 5-Year Plan, 47 million kW of fossil-fired power generating units will be commissioned nationwide; by the end of 1995 the total capacity of fossil-fired generating units in the 50,000-kW class or above will be 120 million kW and annual coal consumption will reach about 380 million tons. The output of pollutants will increase greatly. In certain locations, environmental protection will become the limiting factor in the growth of power production. As a consequence, assuring that the construction of power plants is coordinated with environmental protection and finding ways to convert constraints to stimuli are subjects that must be investigated and solved during the Eighth 5-Year Plan.

In keeping with the State Council's decision to further intensify environmental protection activities, the guiding ideas for environmental protection in the electric power industry during the Eighth 5-Year Plan are: further implementation of the general guideline of "a primary focus on prevention, coordination of prevention and control, and use of integrated management"; constant efforts to assure that pollution control and energy conservation are coordinated with integrated utilization; stringent control of new pollution and accelerated control of existing pollution sources; tighter management, utilization of scientific and technical progress, identification of unused potential, deriving greater overall benefit from investments in environmental protection facilities, and a striving to integrate economic benefits, social benefits and environmental benefits.

The pollution control objectives are as follows.

(1) An average flyash removal rate of 95 percent in the flyash removal facilities of power plants directly subordinate to the power grid, and maximum particulate emissions of 4.6 million tons.

(2) Construction of two or three demonstration coal-fired power plant sulfur dioxide removal projects at power plants burning high-sulfur coal or plants burning moderate- to low-sulfur coal in regions with serious sulfur dioxide pollution.

(3) Integrated utilization of 27 million tons of powdered coal ash, cessation of ash disposal in rivers by all power plants, recultivation or afforestation of full ash dumps, and protection against secondary pollution; construction of demonstration down-mine ash disposal projects pit-head power plants and the development of underground ash disposal.

(4) Universal compliance with disposal standards for power plant wastewater, and construction of closed-cycle boiler ash flush-water systems at 40 percent of all power plants.

(5) Secure sealing of all old power-production equipment containing polychlorinated biphenyls (PCB's).

In order to realize the above pollution control objectives, the following measures must be taken.

A. The use of effective energy conservation measures and the pursuit of energy policies that benefit environmental protection.

The State Council long ago announced the basic policy guideline of "an equal emphasis on development and energy conservation" in China's energy field. This is a mandate to decrease energy consumption and increase economic benefits, but is also one of the basic measures for realizing long-term coordinated development of economic construction and environmental protection. Therefore, during the Eighth 5-Year Plan we must take steps to decrease coal consumption by power plants; new plants must be based primarily on high-performance 300,000-and 600,000-kW units and high-capacity supercritical-pressure units, and in addition, we must accelerate the modernization of low-efficiency generating units at older power plants so that the average annual coal consumption in fossil-fired power plants is brought down to 4 to 5 grams of standard coal per kilowatt-hour.

We must stringently limit small-scale condensation-type fossil-fired power generation and require that all existing small fossil-fired power plants that are able to do so gradually modernize themselves as small heat-and-power plants. We must retire 6.55 million kW of

small medium- and low-pressure units: these small generating units use outmoded equipment, have high coal consumption, and produce serious pollution, and the Ministry of Energy has resolved to take them out of production or convert them to heat-supply stations.

In future environmental evaluations of new projects and of expanded or modernized facilities, the above requirements must be stringently applied.

B. Continue to promote the environmental-protection performance responsibility system.

A new cycle of management contracting has now begun. All contracts and agreements that power management offices and electric power offices sign with power plants must be based on environmental-protection requirements and must specify new management objectives; in the case of key control projects and major environmental problems, they must be based on current circumstances but also take account of long-term concerns and must tighten oversight and inspection and assure that the environmental-protection performance responsibility system is implemented at every level. In order to implement the principle that "environmental protection must be made a compulsory evaluation criterion for enterprise upgrading and for identifying advanced, enlightened units," which was enunciated by the State Council in its "Decision on Further Strengthening Environmental Protection Efforts," we must further strengthen environmental management and see to it that power-plant status-upgrading evaluations and activities based on the "two-enlightened" program produce a further rise in enterprise standards of environmental-protection work.

C. Closely monitor "three-simultaneous" activities.

During the Eighth 5-Year Plan, construction will begun on 42 million kW of new fossil-fired power plants and 47 million kW of new capacity will be commissioned; we must achieve 100-percent implementation of the "three-simultaneous" program, and pollutant emissions of newly commissioned generating units must comply with national or local standards. In order to administer the law strictly, in the future no environmental protection project that has passed its preliminary design review may be changed arbitrarily. If the initial specifications require adjustment, the environmental-protection department of the original reviewing body must give its approval. If design changes are made without authorization, all fees or penalties imposed for the failure of power plants to meet emission standards shall be paid by the units that made the changes.

Oversight of the quality of environmental protection facilities and construction work must be stepped up. Inspections of the "three-simultaneous" activities last year revealed that the wastewater processing facilities of some power plants were of very poor quality, and that even after the work was done over or the facilities were reconstructed, they did not satisfy the "three-simultaneous" requirements and were economically wasteful. Some imported electrostatic precipitators were very poorly installed, so that operating safety was degraded and flyash emissions exceeded the standards. As a consequence, all electric power management administrations and electric power administrations must attach full importance to assuring the high-quality construction of environmental protection facilities and assure that no new environmental problems are left for the operators of the plant to deal with.

D. Use new technologies for effective control of pollutant emissions.

We must begin by conscientiously evaluating and screening existing technologies, disseminate them throughout the country and get them into production as quickly as possible. New research projects must avoid reproducing earlier low-grade developments. The principal objectives of breakthrough projects during the Eighth 5-Year Plan are: first, integrated wastewater management, wastewater utilization, and necessary auxiliary technologies such as protection against pipeline scale; second, demonstration projects on down-mine disposal of powdered coal ash to serve as a source of data for the development of this technology; third, assimilation of the imported stack-scrubber sulfur dioxide removal system that is being used at the Luohuang power plant. Two or three demonstration sulfur dioxide removal facilities designed for coal grades with various sulfur contents should be built during the Eighth 5-Year Plan in order to lay down a good technological foundation for future power-plant sulfur dioxide removal efforts. One approach is to follow the example of the Baima power plant, which used intermediate results from an experimental study of the rotary-spray dry sulfur dioxide removal technique to establish a pilot production-scale installation capable of handing an amount of smoke equivalent to that produced by a 100-kW generating unit and which imported "in-furnace calcium-spray activation and humidification" sulfur dioxide removal equipment and circulating fluidized bed technology.

Newly commissioned generating units with capacities of 200 kW or more and all new units located in municipal areas must make use of highly efficient electrostatic precipitation. All plants that have installed electrostatic precipitators and have a place to dispose of dry ash must use multilevel ash disposal, so that powdered coal ash resources will be rationally utilized.

New ash transport systems must use concentrated transport. Localities that are able to do so must use dry ash removal and dry ash storage, gaining control of the amount of ash-removal water used and of the extent of external disposal. Efforts must be made to increase the condensation factor of cooling towers and to decrease water consumption and pollutant emissions.

E. Find unused potential, increase the operating efficiency of existing environmental protection facilities, and maximize the benefit from the investments embodied in them.

During the Seventh 5-Year Plan, despite a scarcity of funds, the state nonetheless made large investments in environmental protection facilities for fossil-fired power plants. But the facilities that have been commissioned are plagued by numerous problems, the most nagging of which involves electrostatic precipitators. Nationwide, there are now 198 electrostatic precipitator units, accounting for 33.1 percent of total boiler capacity. The electrostatic precipitator facilities for a 300-kW generating unit cost nearly 10 million yuan and consume more than a thousand tons of steel, making them the fourth most important component of the power plant; but at present fewer than 50 percent of them are being managed effectively, which constitutes a major problem. Unskilled management of precipitator units results in their failure to achieve their rated performance, which decreases their efficiency and also is detrimental to safe, stable operation of the generator units. Owing to design and installation problems with the electrostatic precipitator units at the Dawukou power plant, only a small fraction of them went into operation; in those that were put into use, blower abrasion was so serious that the blowers had to be shut down for repairs after less than a month, with the result that the annual energy output was decreased by 100 million kWh. New repairs made last year finally solved the problem. But we should learn a lesson from this situation. Some electrostatic precipitators imported at a high cost in foreign exchange are ineffectively operated, their control rooms are filthy, and the advanced equipment has not produced the expected benefits, resulting in great waste. Steps should be taken to rectify such situations; the work should accorded full importance, and efforts should be made to achieve good performance and to reap benefits from environmental protection investments.

In addition to problems of awareness, there are also problems of organization. The Zouxian power plant's four 300-kW generating units all have precipitators, and one important factor in their effective operation has been the use of a unified system for managing flyash removal and boiler ash handling, based on the distinctive characteristics of electrostatic precipitators and their close relationship to boiler ash handling, placing management efforts on a sound footing. The China Energy Corporation's Electric Power Development Company has imported foreign equipment and monitoring instrumentation; it is to be hoped that it will conscientiously summarize experience and strengthen management, so that all power plants will be able to have top-quality facilities like those of the Dalian and Fuzhou power plants and top-quality operation and management standards will be developed.

F. Make use of the favorable opportunities offered by the policy of reform and opening to the outside and by current international concerns to expand international technical exchange and cooperation in the environmental protection field.

In recent years, when the World Bank, the Japan Overseas Cooperation Fund and other organizations have provided China with loans for the construction of fossil-fired power plants, they have imposed stringent environmental requirements and have made the awarding of the loans contingent on advance approval of the project by international environmental experts. We must learn from the environmental evaluations of the Zouxian and Ezhou power plants in order to obtain good environmental evaluations in support of future loan applications. A major current focus of international environmental concern is global climatic change, one aspect of which is the relationship of energy development and utilization to the environment. China's power industry is primarily coal-based, and this structure will not be significantly changed for a long time to come. As a consequence, the current trends of international environmental concern provide a major incentive for us to use energy conservation measures, to upgrade energy resource utilization, to decrease emissions of such pollutants as sulfur dioxide, carbon dioxide and nitrogen oxides, and to make a contribution to the global environment; the situation also offers us the opportunity to open to the outside world and to seek cooperation. We must take advantage of this favorable opportunity, publicize our power industry's efforts in environmental protection, and make every effort to import advanced foreign technology and funding in order to promise domestic antipollution efforts.

G. Structural Concerns

Premier Li Peng has frequently emphasized that we must strengthen China's environmental protection structure. Tighter management is impossible without appropriate structures and competent personnel. Environmental protection work by the power management administrations and electric power administrations is expanding steadily, but the current personnel of some offices have an inadequate understanding of the subject. In the structural reform we do not require that organizations at different levels all follow the same pattern, and in particular many offices have the task of streamlining their organization, but we must emphasize that every office must act, in keeping with its tasks, to establish a sufficiently large, competent manpower pool and to have it deal effectively with the increasingly complicated environmental tasks. Otherwise, the offices will not be able to cope with all of their responsibilities. In addition, full use must be made of cooperation between departments. Environmental protection activities involve organizations in the areas of planning, capital construction, plant operations, science and technology, foreign affairs, finance and the like, and we must motivate all of these organizations.

In the next 10 years, energy development will continue to implement the basic guideline of "centering on electric power, with coal as the foundation"; this fact further intensifies our social responsibility in environmental protection. In order to create wealth for future generations and for mankind as a whole, we must overcome

difficulties and strive to perform effective environmental protection work in the electric power industry, raising pollution control efforts in the industry to a new level.

Rural Energy Shortage Is at Top of Agenda

40100019A Beijing CHINA DAILY (Opinion) in English 23 Jan 92 p 4

[Article by Zhai Feng: "Rural Energy Shortage Is at Top of Agenda"]

[Text] Despite steps taken to produce more energy resources in the last few years, rural areas are still lacking oil, coal and electricity to fuel furnaces and machines.

According to the Ministry of Energy, the average per capita energy consumption in the countryside is only 0.38 tons of standard coal each year, less than half the national level.

Rural areas face shortages of nearly 4 million tons of diesel oil, 20 billion kilowatt-hours of electricity and about 16 million tons of coal each year.

That is why overcoming energy shortages is now on top of the government agenda.

A four-day conference in Beijing, which wound up on January 14, launched a five-year energy programme to alleviate energy shortages in the countryside.

The meeting was co-sponsored by the State Planning Commission (SPC), the Ministry of Agriculture, the Ministry of Finance, the Ministry of Water Conservation, the Ministry of Energy, and the Ministry of Forestry.

The programme, which will be implemented from 1991 to 1995, encourages 100 counties to exploit wind, solar, geothermal and tidal energy, hydropower, marsh gas and other energy resources—and to protect the environment—in a bid to develop local economies.

On January 13, Premier Li Peng told the meeting's participants, "All the rural areas must put equal emphasis on energy resources development and conservation."

The SPC and the Ministry of Finance will jointly invest 4 million yuan ($740,740) in the programme each year, while local governments will inject 14 million yuan ($2.6 million) into it.

This programme is another big step taken by the government to deal with rural energy shortage problems.

Since 1983, the government selected 18 counties to experiment on rural energy resources exploitation in a comprehensive way.

Through developing solar energy, bio-gas, hydropower or coal, these counties have succeeded in solving their energy shortages.

At the conference, Ye Qing, Vice-Minister of the SPC, said, "In the coming years, rural areas will have to spend more money on reinforcing energy-saving technology research and expanding the research findings."

Fruits of the past efforts have proved that such ideas work.

The SPC data showed that more than half of rural families utilized energy-saving stoves by the end of 1990, and as a consequence saved 35 million tons of crop stalks and firewood each year.

And at least 3 million hectares of young trees are conserved a year, thus slightly easing the country's soil erosion problem.

During the last 10 years, more than 3.9 million hectares of forest have been planted, and as a result the nation can produce 140 million tons of firewood each year.

Zhu Liangdong, deputy director of the Department of Resources Conservation and Comprehensive Utilization under the SPC, said that the increase in firewood reserves has relieved strains on the country's firewood supplies.

Bio-gas has also become a popular energy resource in the countryside.

According to the SPC, nearly 5 million rural families have employed bio-gas to stoke furnaces around the country.

Moreover, rural areas have reaped benefits from the development of new energy resources such as tide, wind, geothermal and solar power.

Vice-Minister of Agriculture Hong Fuzeng said that about 3,200 service industries have been set up to spread new energy-saving technology and products during the past few years.

"To further develop energy resources is critical to the target of assuring farmers decent food and clothing by the end of this century, which was a goal set by the government in the early 1980s," stressed Gu Shuhua, deputy director of the Rural Energy Branch of the China Energy Research Society.

He said in an interview with China Daily that energy shortages in the countryside are an aftermath of former government policies.

In the 1970s and early 1980s, when the energy industry in China was underdeveloped, the government did not cover the rural consumption of commodity energy resources, such as coal and oil, in the economic plans.

Even today the bulk of commodity energy resources are controlled by government plans, so rural areas have many difficulties in purchasing needed energy resources.

Each year commodity energy resources allocated to rural areas by the government total no more than 200 million

tons of standard coal less than one-fifth of the country's total, although rural industries produced about one-third of the country's total goods and services.

Gu estimated that commodity energy resources consumed annually by rural industries and agriculture are equal to 5 million tons of standard coal.

Another cause of the energy shortages in the countryside is the low growth rate of the energy industry.

Due to the booming rural industries, on average the rural consumption of commodity energy resource has increased by 15 percent each year during the past decade, faster than the energy industry.

"The future energy situation is serious," said Zhu Liangdong, who is in charge of the work of the 100 counties' future energy exploitation and conservation.

He estimated that the consumption of commodity energy resources in rural areas is to reach about 700 million tons of standard coal by the year 2000.

Energy shortages in the countryside have incurred serious damage to the environment, Zhu commented.

Each year more than 200 million tons of firewood and crop stalks are burned, usually crop stalks considered valuable organic fertilizers, causing a decline in the fertility of cultivated land.

In addition, farmers who lack fuel probably cut trees and grass to burn in their stoves, and as a result aggravate the country's soil erosion problems.

More worrying is that rural areas with a shortage of energy supplies, where the economy is underdeveloped in most cases, suffer from poverty, Zhu said.

Scientists Claim Another Breakthrough in Super Fuel Development

926B0035C Beijing BEIJING KEJI BAO [BEIJING SCIENCE AND TECHNOLOGY NEWS] in Chinese 6 Nov 91 p 1

[Article by reporter Chen Zhiqiang [7115 1807 1730]]

The invention of a cheap, abundant, non-polluting super fuel is a difficult scientific undertaking that the whole world is anxiously waiting for says the World Future Association. Chinese scientists and technicians have recently made breakthroughs in their research into this scientific problem.

The Deputy Chairman of the China Information Association, Invention and Manufacturing Specialty Committee, Zheng Xitong [6774 6932 0681] and comrades of his task group recently invented the civil-use Model-1 hydrolytic hydrogen-ion fuel that conforms with the super fuel expressly desired by the World Future Association. It uses a special catalyst which reacts with the high temperature of the fuel agent, separates out the hydrogen ions and associated combustible gases, and burns with a higher efficiency than coal gas, and it is safe and non-explosive.

After the civil-use Model-1 hydrolytic hydrogen-ion fuel came out, under the care and guidance of the National Planning Commission and State Commodities Bureau, the task group, headed by Zheng Xitong, began research on the industrial Model-1 hydrolytic hydrogen-ion fuel, and after many reversals, finally succeeded. The test results show that the industrial Model-1 hydrolytic hydrogen-ion fuel, when used in industrial boilers and mixed with a fuel mixture that is 36.5 percent water and a catalyst, burns at a level equal to or exceeding that of heavy oil, demonstrating its excellent future applications in industrial production with social and economic benefits.

Now, preparations for construction of a production base for the industrial Model-1 hydrolytic hydrogen-ion fuel are underway, and it may go into batch production before long.

Three Gorges Project in Energy Generation Context

926B0031 Beijing SHUILI FADIAN [WATER POWER] in Chinese No 11, 12 Nov 91 pp 3-7

[Article by Ministry of Energy Resources vice minister Huang Yicheng [7806 3015 6134]: "Viewing the Three Gorges Project from Power Generation Benefits"]

[Text] The Three Gorges project is a magnificent project that has attracted world attention and is the concern of all the people of China. Since Liberation, under the concern of the CPC Central Committee and State Council, and led by the Chang Jiang Basin Planning Office (now called the Chang Jiang Water Conservancy Commission), a great deal of work has been done concerning planning, surveying, design, and scientific research for this project. From 1986 to 1988, the former Ministry of Water Resources and Electric Power followed the instructions of the State Council and organized experts in all areas for renewed discussion of the necessity, feasibility, and economy of the Three Gorges project. On this foundation, the Chang Jiang Water Conservancy Commission recompiled the Three Gorges project feasibility research report in 1989. In 1991, the State Council Three Gorges Project Inspection Committee inspected the feasibility research report and further clarified the status and role of the Three Gorges project in development of the Chang Jiang as well as its construction scale and comprehensive benefits. Based on the discussions of the experts, the Three Gorges project would play an irreplaceable role in dealing with the threat of flooding on the middle and lower reaches of the Chang Jiang and would have significant benefits in water-borne transport, water diversion, and other areas. From the power generation perspective, it is also a hydropower station with very good benefits. I will discuss here my individual understanding solely of the power generation benefits and role of the Three Gorges Hydropower Station.

I. The Three Gorges Hydropower Station Will Have Huge Power Generation Capabilities and Superior Technical Economics Indices

Based on the 175 meter normal water impoundment level program for the Three Gorges reservoir recommended by the feasibility research report following the renewed discussion, the installed generating capacity of Three Gorges Hydropower Station would be 17,680MW and it would generate an average of 84 billion kWh of electric power each year. This scale can be compared in the following ways. First, Itaipu Hydropower Station, built jointly by Brazil and Paraguay and the largest hydropower station completed in the world so far, has an installed generating capacity of 12,600MW and generates an average of 70 billion kWh of electricity annually. It has been called a "world-class project". Based on information presently available, after the Three Gorges Hydropower Station is completed, it will the largest hydropower station in the world for quite some time to come. Second, since China's liberation, we have completed over 80 large and medium-sized hydropower stations with a total installed generating capacity of 22,520MW and yearly power output of 86.8 billion kWh, which is merely equivalent to the amount of power generated annually by Three Gorges Hydropower Station.

The Three Gorges Hydropower Station also has these advantages: 1) A high number of yearly utilization hours of installed capacity, averaging 4,750 hours, far greater than the average level of 3,600 hours for hydropower in China at present. 2) Comparing yearly power output each year with the average amount of power generated each year over a period of many years, the amplitude of annual variations would be small, generally only about 10 percent. 3) The guaranteed output (design average output during dry periods) is now 4,990MW and would rise with the construction of reservoirs on the trunk and tributaries upstream. The Three Gorges reservoir itself could increase the guaranteed output of Gezhouba Hydropower Station now completed downstream from 768MW to 1,050MW. 4) The reservoir at Gezhouba Hydropower Station could play a reverse regulation role in uneven flow rates discharged from Three Gorges Hydropower Station and enable it to assume grid peak regulation tasks.

The technical economics indices for Three Gorges Hydropower Station are also outstanding for hydropower stations in China. For greater comparability, we can compare Three Gorges Hydropower Station with 17 other large hydropower stations now under construction in China at Longyang Gorge, Dongjiang, Shaxikou, Wan'an, Ankang (these five stations have been completely or partially placed into operation and are generating power), Wuqiangxi, Geheyan, Shuikou, Yantan, Manwan, Dongfeng, Tongjiezi, Baozhusi, Lijia Gorge, Tianshengqiao First and Second Cascades, and Ertan. These 17 hydropower stations have a total installed generating capacity of 18,770MW and average yearly power output of 81.8 billion kWh, so their power generation capacity is about the same as Three Gorges Hydropower Station. Moreover, all of them are projects with relatively superior technical economics indices that were selected through comparison by each province and autonomous region.

First, we can compare the amount of civil engineering for these key water conservancy facilities. The total for the Three Gorges project is 87.89 million m^3 of rock and earth excavation, 31.24 million m^3 of rock and earth fill, and 26.89 million m^3 of concrete to be poured, for average amounts of engineering per kW, respectively, of 4.97, 1.77, and 1.52 m^3 and an average amount of engineering per 10,000 kWh, respectively, of 10.5, 3.3, and 3.2 m^3. The totals for the 17 hydropower stations under construction are 131.25 million m^3 of rock and earth excavation, 43.88 million m^3 of rock and earth fill, and 44.11 million m^3 of concrete to be poured, for average amounts of engineering per kW, respectively, of 6.79, 2.34, and 2.35 m^3 and an average amount of

engineering per 10,000 kW, respectively, of 16.0, 5.4, and 5.4 m^3, all of which are higher than the Three Gorges project.

Second, we can compare reservoir inundation losses. The Three Gorges project will flood relatively little cultivated land but a rather large number of people will have to be resettled. The Three Gorges reservoir will inundate 357,000 mu of cultivated land and 74,000 mu of citrus groves and require the resettlement of about 720,000 people (the number in the 1985 survey). This is an average of 243 mu and 410 people per 10MW and 512 mu and 637 people per 100 million kWh in power output. The 17 hydropower stations under construction will inundate 580,000 mu of cultivated land and require the resettlement of 590,000 people (in all cases, no natural growth was calculated during the period of project construction), an average of 309 mu and 314 people per 10MW and an average of 709 mu and 721 people per 100 million kWh. The population to be resettled for the Three Gorges, however, is mainly an urban population and the usual arrangements can be made for their avenues of production, so the difficulty involved in resettling these people would be slightly less.

Regarding construction schedules, it will take 15 years from the time construction starts until completion at the Three Gorges project. Resettlement of the population from the reservoir will begin during the preparation period and will take about 20 years, which is a rather long time. The construction schedule for most of the several hydropower stations larger than 1,000MW under construction is 8 to 9 years. The Three Gorges project has a prominent advantage, however, which is that less than one-half of the total investment will have to be invested from the start of construction until the 9th year, so cofferdams can be used to impound water for the first group of generators to go into operation and generate power. They can generate a total of more than 400 billion kWh of power by the 17th year. The investment for the later period of construction can depend on its own income from power generation. Gezhouba Hydropower Station has this type of experience and benefit. Construction of this hydropower station resumed in 1974, the first generator went into operation and generated power in 1981, and the project was completed in 1988. It generated a total of almost 60 billion kWh of electric power up to the time it was completed, which is equivalent to the amount of electricity generated by the entire power station in 4 years. This is hard to achieve at other hydropower stations.

There is also a possibility that the construction schedule for the Three Gorges project can be shortened somewhat. For example, the current design for the ship passage facilities during the construction period uses a program that combines temporary locks and ship hoists with an open diversion ship passage channel. Some experts have also proposed another program. If we only used temporary locks and ship hoists, and did not use the open diversion ship passage channel, there would be a substantial reduction in the amount of rock and earth excavation, filling, and concrete engineering for the open diversion channel and the overall configuration of the construction could be simplified, which would greatly reduce the difficulty of construction and help shorten the construction schedule, and it would increase the power generation benefits during the construction period. There would be a problem with a short-term obstruction of shipping when the reservoir starts to impound water, but this could be solved by temporarily using trucks or electric locomotives above and below the dam site to transfer passengers and freight (the costs could be taken out of the project).

The entire investment for the Three Gorges project could be borne by electric power departments and the economic indices would still be superior. Calculated at 1990 price levels, the average investment per unit kW would be 2,732 yuan and the unit investment per kWh would be 0.575 yuan (when including the 500kV power transmission and transformation project, these figures would be 3,224 yuan and 0.678 yuan, respectively). This is very close to the unit investment for the 17 large hydropower stations under construction described above, and is only 20 to 30 percent higher than a thermal power plant (not including the coal mine and transportation investment). Moreover, financial analysis of the Three Gorges project shows that its power generation costs are rather low, the time period to repay the loan would be rather short, and the internal financial income rate and investment profit and tax rates are all higher than the values stipulated by the state. In summary, although the Three Gorges project would involve large investments and long construction schedules, it could make a substantial contribution to the state because of its large power output, low cost, and high benefits.

II. Three Gorges Hydropower Station Is a Realistic, Feasible, and Economically Rational Power Source for the Central China and East China Regions

Everyone knows that central and east China are China's most economically developed regions and occupy an extremely important status in our national economy. They are also the regions where the electric power industry has developed fastest. China's total installed generating capacity in 1990 was 137,890MW, including 20,290MW in the Central China Grid (which includes Henan, Hunan, Hubei, and Jiangxi provinces) and 22,170MW in the East China Grid (which includes Shanghai Municipality and Jiangsu, Zhejiang, and Anhui provinces), and their yearly power output was, respectively, 98.3 billion kWh and 109.1 billion kWh. Moreover, these two grids have formed a preliminary network dominated by 500kV power transmission lines. To achieve our second strategic objective for development of our national economy and society, these two grids will have to generate about 400 billion kWh of power a year by 2000 and their installed generating capacity will have to be greater than 80,000MW. By the year 2015, their yearly power output and installed generating capacity will have to double again. Obviously, to meet this development scale, it is essential that the

Central China and East China Grids build several hydropower, thermal power, and nuclear power plants. As to how many hydropower stations, thermal power plants, and nuclear power plants they will have to build, this will be determined by the feasibility and technical economic rationality of energy resource supplies.

Central and east China are both regions with energy resource shortages. These two regions have developable hydropower resources of, respectively, 228.5 billion kWh and 17.4 billion kWh, which is only about 12 percent and 1 percent, respectively, of the total for China. Actually, for social, economic, and other reasons, so-called "developable" resources cannot be entirely developed and substantial deductions must still be made. No more than 60 to 70 percent of the hydropower resources of central and east China are truly developable. In the East China Grid, for example, there are 17.4 billion kWh of resources (mainly in Zhejiang Province) and about 7.0 billion kWh has already been developed. There are only a few sites where the remaining portion could be developed at any substantial scale. The 228.5 billion kWh in the Central China Grid is mainly distributed in Hubei and Hunan Provinces and about 50 billion kWh has already been developed (including projects under construction). That remaining to be developed is mainly the Three Gorges Hydropower Station.

The four provinces of the Central China Grid have just 2.9 percent of the available reserves of coal resources in China, mainly in Henan Province. The three provinces and one municipality in the East China Grid have just 3.5 percent of China's total and most is in Anhui Province. Their yearly coal output falls far below needs at present and they must rely on in-shipments from other regions. As for the coal used to generate electricity, the two grids generated 139.9 billion kWh in power in 1985, of which thermal power accounted for 118.1 billion kWh, and they consumed 58.6 million tons of raw coal, with 22.96 million tons or two-fifths being shipped in from other regions. They generated a total of 207.4 billion kWh of electricity in 1990, of which thermal power accounted for 161.3 billion kWh, and they consumed 83.28 million tons of raw coal, with 55.97 million tons or two-thirds being shipped in from other regions. To meet the electric power requirements of these two grids, even with construction of Three Gorges Hydropower Station and other local hydropower stations and the greatest possible effort to build nuclear power plants, they will still have to ship in more than 100 million tons of coal from other regions by the year 2000 and will have to ship in 200 million tons by 2015. When the amount of coal used by other departments is added, they will have to ship in 170 million tons and 300 million tons from other regions.

The coal coming into the central and east China regions from outside is mainly from the Shanxi, Inner Mongolia, and other coal base areas of north China and transportation is a big problem. Shipments of coal to central China rely mainly on railroads while shipments to east China can use a combination of railroad and maritime shipping, meaning that it is first shipped by rail to Qinhuangdao, Qingdao, Shijiusuo, and other harbors and then transferred to maritime transport. There is now an extremely acute contradiction between supply and demand for both railroad transport and maritime transport and the amount of "coal shipped from north to south China" continues to grow, so we must build new railroads, harbors, and the corresponding matching facilities.

We all know that the biggest advantage of hydropower stations is that they use no fuel. In 1990, China's large, medium-sized, and small hydropower stations generated a total of 126.35 billion kWh of electricity, which is equivalent to conserving 65.20 million tons of raw coal when converted to the rate of coal consumption for thermal power in that year. After Three Gorges Hydropower Station is completed, it will generate 84 billion kWh of electricity a year, which can conserve 42 million tons of raw coal. Adding the consumption for long-distance coal transport and other things, the yearly coal savings could reach 50 million tons. From the perspective of coal conservation and transport capacity, the role of Three Gorges Hydropower Station would also be enormous.

If we do not build Three Gorges Hydropower Station, the conclusion from research on the following three substitute programs is that none are as economically rational, realistic, and feasible as Three Gorges Hydropower Station.

1. Substituting coal-fired power. This would involve building several large thermal power plants in the east China region with an installed generating capacity of 17,680MW and building coal mines with a yearly output of 50 million tons in the north China coal base area as well as two railroads with an average length of 1,000 kilometers. Compared with the Three Gorges project, not only does this program involve an enormous scale of mine development and railroad construction as well as considerable capital construction investments, but the power generation costs would also be high, so it is not economically rational. Moreover, construction of coal-fired thermal power plants at a scale equivalent to Three Gorges Hydropower Station would require the discharging of more than 100 million tons of carbon dioxide, 2 million tons of sulfur dioxide, 10,000 tons of carbon monoxide, and 370,000 tons of nitrous oxide compounds as well as large amounts of dregs and waste water each year. Obviously, this is bad for environmental protection in the central and east China regions, which have a dense population and developed economy.

2. Substituting nuclear power. China is only in the initial stages in building nuclear power and we have little experience. Compared to coal-fired power, nuclear power does not involve the problem of transporting heavy fuels and the power generation costs are not high, but since China does not yet fully understand the manufacturing technology, the prominent problem is high construction costs. For example, Qinshan Nuclear

Power Plant in Zhejiang, which was designed and built mainly by China's own forces, will have an installed generating capacity of 300MW in the first phase at a cost of 1.4 billion yuan, which is a unit investment of 4,700 yuan per kW. Daya Bay Nuclear Power Plant in Guangdong, which will have an installed generating capacity of 1,800MW, will take a total investment of about $4 billion when it is completed because all of the equipment was imported as a set from England and France. Their construction costs per unit kW are many times higher than the hydropower and thermal power plants now under construction in China. If we do not build Three Gorges Hydropower Station and build nuclear power instead, we will have to build at least eight Daya Bay Nuclear Power Plants, which will be difficult if not impossible in terms of the investment alone given China's present financial resources, so it is also economically irrational.

3. Substituting other hydropower stations. Based on the undeveloped hydropower resource situation in central and east China that was described above, if we eliminate Three Gorges Hydropower Station, there are no other substitute programs in this region. We have studied a substitute program for Three Gorges Hydropower Station involving two huge hydropower stations at Xiluodu and Xiangjiaba, which have the best conditions in the lower reaches of Jinsha Jiang. The preparatory work for these two hydropower stations has already entered the feasibility research stage and they would have a total installed generating capacity of 15,080MW and generate an average of 81.3 billion kWh of electricity a year. The amount of concrete and civil engineering and the investment for these two key water conservancy facilities would be about the same at the Three Gorges, and their advantage would be that less than one-tenth as much cultivated land would be flooded by the reservoir and as many people would have to be resettled. However, their geographic location is in far western Sichuan, 1,300 kilometers from Wuhan and 2,000 kilometers from Shanghai, so the cost of power transmission projects and power transmission losses would be far greater than Three Gorges Hydropower Station. Moreover, the engineering geology conditions for these two projects are complex, the difficulty in building the hydraulic structures would be considerable, and the construction schedules would be rather long. Added to the inadequate depth of preparatory work at present and the fact that the conditions would not exist to begin construction with the next several years, they are unrealistic.

III. Three Gorges Hydropower Station Has a Suitable Geographic Location and Would Be a Pillar For the Formation of a National Integrated Grid

A primary indicator of a modernized electric power industry is the development of grids and systemization that organizes power generation, power transmission and transformation, power supplies, and power use into a large regional network to form an integrated grid or unified electric power system. Many of the industrially developed nations are making maximum efforts in this area. The Soviet Union, for example, which runs across the Eurasian continent, has now formed a national unified electric power system. Many multinational integrated grids have appeared in Europe. China's electric power industry is also developing in this direction. China has now formed five large regional integrated grids, the Northeast China, North China, East China, Central China, and Northwest China grids. These five large grids had an installed generating capacity of 96,610MW at the end of 1990, equal to 71 percent of China's total installed generating capacity. There is hope that a South China Grid, which would include Guangdong, Guangxi, Guizhou, and Yunnan provinces, can be formed very quickly. With the completion of Gezhouba Hydropower Station, it has been connected to the large Central China and East China Grids via a 500 kV DC power transmission line. The ability of these regional grids to interconnect in the future will depend to a substantial degree on whether or not suitable huge power source sites can appear.

As mentioned previously, Three Gorges Hydropower Station would have an enormous power generation capacity and its geographic location is appropriate. It is precisely in the center of China at a distance of less than 1,000 kilometers to Shanghai in the east, Chengdu in the west, Beijing in the north, and Guangzhou in the south. All of these big cities are within an economical power supply range of Three Gorges Hydropower Station. It can be said that Three Gorges Hydropower Station is an ideal pillar for the formation of a unified electric power system in China. Regardless of this, in the long term, Three Gorges Hydropower Station can also serve as a support point for achieving "transmission of power from west to east China", referring to the development of the abundant hydropower resources of southwest China and transmitting power to central and east China.

Moreover, given the characteristics of Three Gorges Hydropower Station itself, ensuring more economical operation will also require its interconnection with several large grids that are dominated by thermal power. The maximum power output capacity of Three Gorges Hydropower Station will be 17,680MW and the minimum guaranteed output during dry seasons will be 4,990MW, so the difference between these two is 12,690MW. During wet seasons, to foster the maximum benefits from Three Gorges Hydropower Station and allow it to generate at full output of 17,680MW, several grids could shut down more than 10,000MW in generators. When it is at minimum guaranteed output of only being able to generate 4,990MW, more than 10,000MW of generators would have to be immediately started up to provide additional output in order to ensure that power supplies to users are not interrupted. This problems exists at all hydropower stations without sufficient regulation reservoir capacity. Some 70 percent of the power output from Three Gorges Hydropower Station would be generated from May to October each year. To ensure sufficient flood prevention reservoir capacity, it would have to operate at reduced water levels for 4 months out

of each year and would actually become a runoff power station during this period and the amount of power it could generate would depend on how much water was available. This would require supplementation by other power plants. Thus, besides generating power and supplying the central and east China regions, Three Gorges Hydropower Station should also be interconnected with the North China, South China, and other grids for the purposes of national grid integration and to regulate changes in its own power output.

Why are all of the nations of the world concerned with building large grids? The reason is that practice and experience indicate that large grids have these advantages:

1. They help optimize power source structures and fully utilize hydraulic energy. The main power sources in many of China's grids at present are coal- fired power plants or hydropower stations. Thermal power plants dominate the North China and East China Grids, for example, accounting for more than 90 percent. Hydropower accounts for 40 to 60 percent of the Central China and Northwest China Grids. Actual operating conditions show that grids dominated by thermal power have acute peak regulation problems because it usually is difficult to start up and shut down coal-fired generators, their range of output variations is small, and they are slow in carrying loads, which makes it hard for them to meet the requirement of random increases and decreases in grid loads. They are not as good as hydropower stations, whose generators can be started up and shut down flexibly to participate in operation for the special purpose of bearing peak regulation. The problem of being unable to fully and rationally utilize power capacity during wet seasons and having insufficient power supplies during dry seasons are common in grids which have a large proportion of hydropower. Obviously, if these two types of grids could be interconnected, the benefits of mutual supplementation of hydropower and thermal power could be obtained.

2. Time differentials and load characteristics among different regions can be utilized to obtain peak staggering benefits. Differences in geographic locations, time zone and climatic differences, differences in people's living conditions and customs, and in particular the differences in the structure and extent of development of industry and agriculture in each area all directly affect electric power load characteristics. The season, month, date, and time at which maximum loads appear in different grids often occur at different times. If these grids were interconnected, peak staggering benefits could be achieved. For example, the maximum loads during the year in the North China Grid usually occur during the winter whereas the maximum loads during the year in the East China Grid usually appears during the summer, so peak staggering benefits could be obtained by integrated operation of the grids.

3. The benefits of mutual compensation among hydropower stations in each river basin could be obtained. Changes in runoff in China's rivers often occur at different times. For example, the period of plentiful water occurs from June to October in the trunk and tributaries of the upper reaches of the Chang Jiang basin and from April to June in the main trunk and tributaries of the lower reaches of the Chang Jiang. The wet season in the Hongshui He basin is from May to October, whereas the wet season on several rivers in the east China region is from March to July. There are also differences in the regulation properties of the reservoirs at each hydropower station. Some can carry out annual regulation or perennial regulation while others are run-off-type power stations. Obviously, integrating these hydropower stations with different hydrological characteristics and regulation functions would enable mutual compensation of hydrology and reservoir capacity. This would increase guaranteed output and yearly power output and improve the stability and reliability of power supplies from these hydropower stations, so the benefits would be quite substantial. Some planning units have studied the question of carrying out mutual supplementation of cascade hydropower stations on the Hongshui He in conjunction with the Central China Grid that includes the Three Gorges and other hydropower stations in Guangdong and Guangxi. The results of the research indicate that mutual supplementation could increase total guaranteed output from 11,600MW to 14,000MW, so the benefits from mutual supplementation could exceed 2,000MW.

4. It can reduce the reserve installed generating capacity. Besides satisfying maximum load requirements, the installed generating capacity of a grid should also include negative load, accident, overhaul, and other types of reserve installed generating capacity. This reserve capacity must be 20 to 25 percent of the maximum load. Obviously, the larger the scale of grid integration, the stronger the interchangeability of reserve capacity, which can reduce the proportion of reserve installed generating capacity.

In summary, I feel that whether we are speaking of the development needs of China's energy resource industry or consideration of improving economic benefits, the Three Gorges project is a hard-to-come-by and good hydropower station project. To achieve China's magnificent strategic objectives for development of our national economy, it should be included as soon as possible among state projects for construction in the near term. As to whether or not the state's financial and material resources can bear the burden, I firmly believe that while we were able to rely on our own strengths from the 1970's to the 1980's in building the first dam on the Chang Jiang, the Gezhouba project, it should be entirely possible for us to complete the Three Gorges project, which involves less than 2.5 times the total amount of engineering as Gezhouba, from the 1990's to the first part of the 21st Century.

Second Phase of Manwan Passes Approval

926B0047A Kunming YUNNAN RIBAO in Chinese 19 Dec 91 p 1

[Article by Sun Jiafu [1327 1367 4395] and Ceng Baohua [2580 0202 5478]]

[Excerpt] The feasibility report for the second-phase construction for an installed capacity of 250,000 kW at Manwan power station has formally passed national approval.

From 3 to 6 December, at the Manwan power station, the Ministry of Energy Resources, Ministry of Water Conservancy, and the Yunnan Planning Committee presiding over the second-phase construction of the Manwan Power Station Feasibility Report Examination Conference, determined to add to the base of the first-phase installed capacity of 1.25 million kW, by installing a 250,000 kW mixed flow hydraulic turbine unit on the right bank of the power station, using one water intake underground structure. [passage omitted] The second-phase construction of the Manwan power station will begin near the water intake no later than the last half of next year and its completion is guaranteed by the end of 1993.

River Successfully Diverted at Baozhusi Site

926B0047B Chengdu SICHUAN RIBAO in Chinese 30 Nov 91 p 1

[Article by reporters Zhao Jian [6389 1017] and Zhou Fushuang [0719 4395 7175]]

[Excerpts] On the morning of 29 November, the course of the Bailong River, at the Baozhusi hydropower station key national engineering project, was successfully diverted. Construction will now be focused on the main task: excavation of the underground chamber and erection of the 132-meter-high reinforced concrete dam. [passages omitted]

The Baozhusi hydropower station is the second cascade power station on the main stream of the Bailong Jiang in the Jialing River Basin. This power station is a key large-sized hydropower project for comprehensive benefits, mainly for generation of electricity, but also for irrigation, flood control, floating timber, and aquatic farming. Its total reservoir capacity is 2.55 billion cubic meters, its installed capacity is 700,000 kW, its annual output will be 2.336 billion kWh, and after it goes operational, the increased annual industrial and agricultural output value for Sichuan will be nearly 10 billion yuan.

After the Baozhusi hydropower station was listed as a national key project in 1989, the Ministry of Energy Resources' Hydroelectric Engineering Fifth Bureau's 6,000 employees responsible for the project worked over 1,000 days and nights, excavated over 1.1 million cubic meters of earth and rock, poured over 300,000 cubic meters of concrete, and built a reinforced concrete open diversion channel more than 500 meters long and 30 meters high on the right bank.

Construction of Shuangliao Plant Said To Be Going Smoothly

926B0047C Changchun JILIN RIBAO in Chinese 14 Dec 91 p 1

[Article by Zhou Fugen [0719 4395 2704], Su Wancai [5684 8001 2088] and Dai Chunfa [2071 2504 4099]]

[Excerpts] [passage omitted] The Shuangliao power plant passed approval of the State Council in June 1990 as a large-scale thermoelectric power plant, and was listed as a national key project in the Eighth 5-Year Plan, with a total installed capacity of 2.4 million kW, to be constructed in two phases. In the first-phase, an installed capacity of 1.2 million kW will be completed, and an estimated total investment of 1.933 billion yuan will be made. Since construction began in October of last year, provincial, city, and county construction banks collected limited funds keyed to supporting construction of the power plant; the construction banks of Shuangliao County, Siping City, and the province, periodically visited the work site, and quickly solved problems during construction. Before work on the power plant was started, the year's planned investment was set at 30 million yuan, but by the end of June only 11 million was available. The provincial and Siping city construction banks took action and freed up the local reserve credit fund of 2 million yuan, guaranteeing a smooth beginning for construction of the Shuangliao power plant. In April of this year there was not enough money for the advance payment of 10 percent for the three big items ordered by Shuangliao power plant, the boilers, gas turbines, and generators; the leaders and comrades of the three construction banks repeatedly went to the plant to study the situation, gave 15 million yuan of central reserve credit for equipment, extended the 2 million yuan of local reserve credit of the first half year for 2 more years, and pitched in capital construction credits of 30 million yuan. That settled the question of insufficient capital construction and reserve funds.

The provincial, Siping City, and Shuangliao County construction banks not only promptly gave credit support, but actively got involved in administration and saved on funds for the power plant. It was their idea to change the requirement for seamless steel tubing to helical steel tubing, which was accepted by the design department and the power plant, an item which lowered the manufacturing costs by more than 4 million yuan. [passage omitted]

Energy Ministry Takes Steps To Strengthen Coal Industry

926B0036B Beijing JINGJI RIBAO in Chinese 29 Oct 91 p 1

[Article by reporter Xie Ranhao [6200 3544 3185]]

[Text] In view of the shortage of investments in the Seventh 5-Year Plan, a slide in the production of coal may be forecasted for late in the Eighth 5-Year Plan, and the Ministry of Energy Resources, looking to shortened construction periods, now has proposed measures to sustain the development of the coal industry, and during this year and the next, 50 million tons of large- and middle-sized coal mines will go into production.

Since 1990, the national coal supply situation has changed from busy to slack. When supply exceeded demand, an estimated 200 million tons of coal went into national stockpiles, but analysis of national people's economic transportation data shows that in the next several years, the balance between supply and demand for coal may again take a turn for the worse and tighten up. On the one hand, for various reasons the coal industry's trend toward increased output already shows signs of slowing down; and on the other hand, coal requirements for development of the people's economy increase continuously. The electric power industry alone is putting into operation an installed capacity of 9 million kW of thermoelectric power which will increase coal requirements by 20 million tons, and added to that are the new coal requirements for the metallurgy, chemical, and building materials industries. Without a big breakthrough in energy conservation, the needs of national economic development will require a minimum annual average increase of 30 to 40 million tons of coal for the next 10 years.

For this reason, the Vice Minister of the Ministry of Energy Resources, Hu Fuguo, at the close of the Coal Construction and Production Conference on 28 October called on the coal industry to make the most of the opportunity of the present weak coal market, accelerate construction, and, as much as possible, put more mines into operation to guarantee that more coal could quickly be produced should the country need it.

The material that the Ministry of Energy Resources presented clearly shows that the coal industry's plan for this year is for mines to be finished and in operation at 26 locations, with a capability of producing over 28 million tons, of which the Shanxi, Yangquan, Guishigou; Datong, Sitaigou; Gujiao, and Dongqu mines' annual production capacity will be over 4 million tons. Now, among these 26 mines, Fengfeng and Jiulongkou in Hebei; Qitaihe and Tiedong in Heilongjiang; and Jalai Nur in Nei Monggol, are already in operation. Next year's plan calls for mines at 21 locations to go into operations with a production capability of over 27 million tons, of which, only Luanchangcun in Shanxi; Huainan and Pansan in Anhui; and Nei Monggol's Huolinhe open pit third-phase mine, whose combined capacity of up to 14 million tons make up 51.5 percent of all mines coming on line for the whole year.

Henan's Coal Exports Top 1 Million Tons in 1991

926B0046A Zhengzhou HENAN RIBAO in Chinese 11 Dec 91 p 1

[Article by Ka Shutian [0595 2579 3944], Li Zhimin [2621 1907 3046] and Li Shu [2621 2885]]

[Text] By the end of November, Henan's coal exports had reached 1.13 million metric tons, earned 42.62 million U.S. dollars in foreign exchange and exceeded the year's export plan by 450,000 tons. Henan's exports set the highest level in history, jumping from 7th to the 4th highest export volume in the country.

This year the Provincial Coal Department and Coal Export Corporation, facing a weak domestic market and serious coal accumulation pressure, searched for information to open an international market. In March 1991, when it was learned that French markets needed a large volume of semianthracite, a request for an export mission was made to the proper authorities and coal samples were sent out. In the midst of an extremely competitive international market, Henan's Hebi Mining Bureau's semianthracite was chosen by the French and a supply contract for 200,000 tons was signed. Heretofore, Henan coal had been sold to Japan and southeast Asia, but this was the first entry into the European market.

In order to guarantee the quality of exported coal, the Henan Coal Export Corporation frequently sent officials to eight coal export sites including the Hebi, Jiaozuo, and Zhengzhou mining bureaus to conduct quality checks and quantitative inspections, and prevented unwanted coal from leaving the mines, from being loaded onto vehicles, and from being shipped, and they assisted the various export mining sites to solve coal quality facilities issues. The main administrative departments, Zhengzhou Railway Bureau, the Lianyungang and Shijiugang harbor affairs bureaus all fully cooperated to complete the coal export mission.

Lingwu Mines Enter Stage of Full-Scale Development

926B0046B Yinchuan NINGXIA RIBAO in Chinese 3 Dec 91 p 1

[Article by Ma Saijiang [7458 1049 3068]]

[Excerpt] The big Lingxin shaft in the Lingwu mining district, the Yangchangwan No 1 mine, the railroad branch line, and mining district water and electric supply projects were formally started on 2 December, indicating that the mining district construction has entered a full-scale development stage.

The big Lingxin shaft, the major project of the Lingxin mine, designed for an annual output of 1.65 million tons,

is ready for construction. The Yangchangwan No 1 mine, originally a local project, was officially redesigned as an extraction district of the Yangchangwan mine; scheduled for an annual output of 300,000 tons, it will first be started as a small mine.

The Lingwu railroad branch line is one of the key projects for developing the Lingwu mining district and speeding up the construction of the energy base. This project, starting in the west, connects a station of the Daba power plant and Daba railroad station on the Baotou-Lanzhou rail line; passes over the rail line and heads east to the vicinity of Wuzhong, Chenyuantan; passes over the Huang He to the terminus of the line, the Guyaozi district station. Track will be laid for a distance of 70.2 kilometers for the main line. The key engineering point of the entire line is the large Huang He bridge, which has a length of 1,643.58 meters.

Supply of electricity and water is a key element of the full-scale engineering for the Lingwu mining district. The selected water sources are located south of the seat of Lingwu County, and Jinyintan, east of Wuzhong. The volume of water to be provided is 30,000 cubic meters per day, utilizing three cascades to increase the pressure and a single pipe to bring the water a distance of 65 kilometers. Power supply construction outside of the mining district is divided into two parts: the mining district 110 kv transformer station, and transmission lines outside the mining district. The Wuzhong line is a 30.2 kilometer single loop, and the Lingwu line is a double loop, each loop being 30.6 kilometers.

These projects are being constructed to assure a coal supply for the Daba power plant and to enhance development of the economy in the minority people's area. [passage omitted]

Shanxi Pilot Plant To Extract Fuel From Lignite

926B0036C Beijing ZHONGGUO KEXUE BAO in Chinese 11 Dec 91 p 2

[Article by reporter Chen Xiechuan [7115 0588 1557]]

[Text] The CAS Shanxi Coal Chemistry Institute has researched the extraction of fuel oil from lignite (pilot), and after 3 years of effort, it passed the approval of experts at Taiyuan. The Approval Committee, headed by Academic Department Committee member Zhu Yajie [2612 0068 0267], considers this Chinese-originated technological achievement to be world class.

Because of its high water content, lignite has a low heating value. It is mainly found in northeast China, Nei Monggol, and Yunnan. How to convert lignite on location for multipurpose use [such as fuel oil] is a major concern for lignite producing areas, and there is a pressing need for such conversion in those provinces and regions where there is lignite, but insufficient petroleum (such as Yunnan Province).

Beginning in the 80's, researchers at the Shanxi Coal Chemistry Institute began to apply the supercritical fluid extraction technology, which is gradually being developed, to the conversion of coal. In 1986, they developed technology for a small-scale sustained conversion of 0.2 to 0.5 kilograms of coal per hour. In 1988 they entered the lignite supercritical fuel oil extraction technology into the scientific research plan. After several years of effort, the Coal Chemistry Institute established a pilot apparatus for converting 30 kilograms of lignite per day, which can extract fuel oil and separate out residual coal. According to the analysis of this black fuel oil, the hydrocarbon atoms are similar to those of natural gas and crude oil, and with further processing, it could yield various engine fuels.

Because of China's particular situation where coal is plentiful and petroleum is in relatively short supply, the approval committee considers that this pilot apparatus has obvious practical value, and suggests that specific national, provincial, and municipal departments set up projects to conduct intermediate testing.

1991 Production of Oil, Gas Revised Upward

926B0044A Beijing RENMIN RIBAO in Chinese 31 Dec 91 p 1

[Article by China News Agency reporter Zhang Zhaowen [1728 6606 2429] and reporter Fei Weiwei [6316 0251 0251]]

[Text] This year's total production of petroleum was 139.6 million metric tons, and natural gas was 14.9 billion cubic meters, surpassing national plan quotas and reaching the highest level of oil and gas production in history.

While the old primary oil fields in the east maintained steady output this year, with the Daqing, Shengli, Liaohe, and Karamai oil fields all holding their average levels of production, the Tarim, Tu-ha, and Junggar basins typified the outstanding performance of western oil fields. This year's new proven petroleum reserves have reached 550 million tons. In natural gas prospecting and production, a find of very promising gas-bearing structures has been made in the Shaanxi-Gansu-Ningxia region, and proven reserves exceed 80 billion cubic meters. China's largest natural gas area, Sichuan, produced 6.47 million cubic meters of natural gas this year, another all-time high.

Eastern Qaidam To Be Developed Into One of Nation's Biggest Gas Fields

40100021A Beijing CHINA DAILY (Economics and Business) in English 13 Feb 92 p 2

[Text] Xining (Xinhua)—The eastern section of the Qaidam Basin in Northwest China's Qinghai Province will be developed into one of China's largest natural gas fields.

Geologists have conducted a continuous exploration and research effort in Northwest China in the past two decades, and have discovered six large natural gas deposits in the Tainan and Sebei regions in the Qaidam Basin.

Exploratory drilling at 125 separate sites has resulted in discovery of natural gas deposits. Geologists estimate that each of the sites will produce a daily yield of over 50,000 cubic metres of natural gas. Drilling records reveal that the deposits lie at a depth of less than 2,000 metres, and that the bottom pressure of the deposits reach 40 kilograms per square centimetre—enough pressure to move the gas through the pipeline.

According to experts, analysis has revealed that the natural gas deposits consist of over 90 percent methane, thereby making it convenient to process the gas into fuel and raw materials for the chemical industry. The experts predict that a large natural gas field with an annual production capacity of over 1 billion cubic meters will be developed in the Qaidam Basin, and that the gas reserves will last for at least 20 years.

Marked Improvement in Drilling Technology at Shengli

926B0051B Shanghai WEN HUI BAO in Chinese 12 Jan 92 p 1

[Article Wei Dong [7614 2639], Chen Xiao [7115 2556], and Xu Yangang [6097 0917 0474]]

[Text] Drilling technology at Shengli oil field has advanced markedly under a relentless research attack. In 1991, the Shengli Petroleum Administrative Bureau Well Drilling Corporation drilled 1480 wells, of which 340 involved a variety of special techniques, and 34 percent of them involved technological accomplishments that were world class or better.

In recent years this corporation has concentrated on research and the dissemination of new technology, and drilling has gradually evolved from ordinary vertical wells to the development of special well drilling techniques.

Through many years of effort Shengli oil field has become not only proficient at directional drilling and multiple well technology, but has explored and succeeded with special technologies not often seen in the world, such as, open-port well casings, multi-bottom wells, three-dimensional barrier winding wells, and has developed as many as eight or more special techniques.

In January 1991, the Oil Field Well Drilling Corporation, at Chengkou oil field drilled China's first horizontal well with a maximum angle of 93.26 degrees, a 505 meter horizontal segment that traverses 211.5 meters of oil layer, or about 7.5 times that of any well drilled vertically, and it has a daily output of over 230 tons of crude oil, about equal to nine wells in the area, paying back its investment in less than one-half year. The corporation was also the first to successfully drill 7 kinds of special-technology wells, including China's first tunnelled horizontal wells, among which two were medium radial-curvature horizontal wells that are longer than the medium radial-curvature horizontal wells operated by the three major U.S. oil corporations. At Caichai oil field, a horizontal well for thermal extraction of heavy oil from conglomerate strata, is an expressly major breakthrough, as no records of this technique anywhere in the world can be found.

In 1991, Shengli Oil Field Well Drilling Corporation set up 34 research projects and 13 new technology dissemination projects, and by the end of the year all had been accomplished, including four that passed national approval and four that earned national patents.

Exploration in Tarim Region Stepped Up

926B0049B Urumqi XINJIANG RIBAO in Chinese 23 Dec 91 p 2

[Article by correspondent Zhang Wenye [1728 2429 2814]]

[Text] Strengthening science and technology in the Tarim prospecting area is premptory for production

strength: Spreading the use of new domestic and foreign technology and processes is the correct way to make use of scientific progress for prospecting results and economic profits.

—In the finding of oil and gas strata, the full utilization of new 1980's technology to prevent oil and gas strata seepage has raised the prospecting success rate. In the process of drilling wells in this prospecting area, the application of full-scale systems technology such as advanced comprehensive well-logging technology and quality slurry technology, made monitoring and recording during drilling operations more accurate, and data recording more precise. Because of the accuracy of all of the data, advanced monitoring procedures, and the scientific processes and techniques, in the oil fields now being found prospectors are all striking oil on their first entry into oil strata. In the drilling of deep and super-deep wells, the full-scale application of new technology has raised the speed and quality and lowered the costs of drilling. Statistics show that from January to August of this year [1991] the average depth of Lunnan exploratory wells was 5,302 meters, the average well construction time was 148 days, and the average unit-cost was 2,925 yuan per meter, a performance that leads the country.

—Spreading the use of modern seismic prospecting and comprehensive research technology has improved the recognition of patterns of distribution of oil and gas in the basin. The use of new technology of repetitive high resolution collection and processing in seismic prospecting was widely applied in the prospecting area.The world's advanced theories of petroleum geology of the 1980's were widely applied in comprehensive seismic research. Digital processing of well measuring data to compute deposit parameters was used. In a few short years, 58 exploratory wells were drilled in the prospecting area, 30 of which turned up flows of industrial grade oil and gas, bringing the exploratory well success rate to 53 percent and above.

—For drilling and prospecting in the desert, the latest foreign and domestic equipment and technology were used to make better inroads into large-scale operations in the inner-desert. The latest foreign desert transportation equipment was imported, and not only have complete drill rigs been moved into the inner-desert, but marshlands and shallow-seas well piling technology were brought in to build well-drilling foundations on a base of fine sand 300 meters deep. Five wells have now been set up, of which the Tazhong-1 well, being the deepest at a depth 6,505.3 meters, is on a solid foundation, and it has brought up a high-yield flow of oil and gas from the ordovician system strata. To further develop prospecting in desert areas, a desert road has been surveyed, the route selected and approved, and various types of new technology and materials have been used to complete a two-kilometer test segment of desert road.

—The full dissemination and use of high technology has greatly sped up the pace of Tarim's prospecting and development. Within just a few short years, the Lunnan, Donghetang, Yingshili, and Kelake oil fields were found ready for exploitation, and they already provide the 5 million tons of crude oil reserves for 1995 production.

Daqing Maintains High Output

926B0051A Beijing RENMIN RIBAO in Chinese 9 Jan 92 p 1

[Article by reporter Xu Yingjie [1776 5391 0267]]

[Text] Daqing Municipality's petroleum output in 1991 was 55.623 million metric tons for a record 16 consecutive years of crude oil output above 50 million tons.

The Daqing Municipality Committee Secretary, Zhang Hong, explained to reporters that because of steady high output of petroleum and advances in petroleum processing, the municipality's total financial returns reached 3.67 billion yuan, the highest in history. The municipality's total output surpassed the national plan by 223,000 tons; production of natural gas was over 2.27 billion cubic meters, an increase of 13 million cubic meters over last year; and 443,000 tons of light hydrocarbons were produced, 26 percent over the national plan.

New proven petroleum geological reserves were over 80 million tons; 7.82 million tons of petroleum were processed producing 304,000 tons of ethylene, 260,000 tons of plastics, and 38,000 tons of acrylic fibers, all well over last year's volumes.

Working Conference Assesses Oil, Gas Development in Yunnan-Guizhou-Guangxi Region

926B0049A Kunming YUNNAN RIBAO in Chinese 27 Dec 91 p 1

[Article by He Longxiang [0149 7893 3276]]

[Text]According to information learned from the "Yunnan-Guizhou-Guangxi Region Prospecting and Development Working Conference", and "Yunnan Province Oil and Gas Prospecting Deliberation Conference", just adjourned, oil and gas prospects in the Yunnan-Guizhou-Guangxi region are good, it is China's bastion in reserve, and the end of Yunnan's total oil deficiency is in sight.

At the behest of the provincial government and the Yunnan-Guizhou-Guangxi Petroleum Prospecting Bureau, 31 of China's learned, experienced, and accomplished petroleum experts came to Kunming to participate in the deliberations and give their guidance. During the 5-day conference, the experts assessed the historical and present prospecting in the Yunnan-Guizhou-Guangxi region, analyzed and discussed the comprehensive research done on the geology of the Yunnan area and the region, and unanimously agreed that the 783,000

square kilometer area, which holds 1.73181 billion tons of crude oil resources, and 1.7525 to 1.8593 trillion cubic meters of natural gas, is a prospecting territory with great potential.

This deliberation conference set five targets for Yunnan:

1) a reappraisal of the Jinggu Basin to raise crude oil production as quickly as possible;

2) re-visiting the Yanglin-Kunming basin for development of near-surface natural gas resources, and looking for the most efficient and most economical technological processes for drilling and exploitation;

3) at Longchuan basin, one of the "seven sisters" of western Yunnan, exploitation of the Longcan-1 well should continue, and general seismic investigations of all of the seven western basins of Yunnan should be carried out;

4) early-stage prospecting, selecting of good structures, and predictive prospecting in the Simao basin;

5) the Chuxiong basin must be listed among prospecting research projects, and outside cooperation must be actively pursued.

Zhongyuan Is Tempting Target for Oil and Gas Theft

926B0044B Beijing RENMIN RIBAO in Chinese 17 Dec 91 p 5

[Article by reporter Zhu Sixiong [2612 1836 7160]]

[Text] Creating an excellent external environment is an important task that large-and middle-sized enterprises must get done well. But, in recent years some enterprises are perplexed by the daily worsening environment, as theft and plundering of all sorts of materials are seriously affecting production and development. Because the Zhongyuan oil field, located on the boundary of Henan and Shandong is one of the locations so affected, reporters paid a visit to investigate.

Oil fields are not fenced in, and their production areas are often near villages, presenting difficulties for oil field management. Zhongyuan oil field is located in the densely populated Zhongyuan zone, which increases the difficulty of oil field management. The theft in the area reporters visited on their fact-finding mission is shocking.

Theft of oil. Some outlaw elements often target high-flow oil wells that are not far from villages and are close to roads. First, they dig a ditch beside the wellhead, and then open the valves on the oil line, let the oil flow into the ditch, and after the oil thickens, they take it out and sell it. They steal from 5 to 6 kilograms up to 1 or 2 tons of oil at a time. The keepers of earthen refinery stoves in a village in Dongming County where the No 6 oil extraction plant is located bought over 4,000 tons in one year, equivalent to nearly one week's crude oil output at the extraction plant.

Theft of electricity. The villages around the oil district of the Zhongyuan oil field basically have no normal electric supply system, but every night they are illuminated. Homes are lit up, and workshops and flour mills are electrified. It turns out that almost all of the electricity is bootlegged from oil field power lines. At one well of the No 6 oil extraction plant, reporters saw a power cable connected to a motor that had been stripped and about a dozen lines that led into a village were connected to one cable strand. In the most extreme case, over 70 lines for stealing power terminated at one transformer of an oil well. According to incomplete statistics from one Zhongyuan public security office, 80 million kWh of electricity were stolen from the oil field between January and August of this year.

Theft of gas. Several villages near the oil field, making the best of on-the-spot "resources" to get gas for cooking, drill holes into the natural gas pipelines and fill up bags sealed to the holes, which they take away for use; some people even simply hook up gas lines which lead directly to their own homes. It was explained that from January to August of this year the oil field public security office discovered and plugged up over 110 holes and cut off over 13,000 meters of lines used for stealing gas.

Theft of materials. The reporters saw an oil well power distribution panel in which almost nothing was intact, the fuse mechanisms inside being totally disassembled. At the No 6 oil extraction plant reporters also saw a measuring station that had been emptied by looters, from the doors and windows to the tables and chairs, and not one of the instruments and meters had been spared. In the first 8 months of this year, 960 drilling rods, 874 oil pipes and 349 pylon angle-irons for cable towers had been taken from the Zhongyuan oil field.

In the past outlaw elements were stealthful, but now they blatantly operate in broad daylight. On 26 September this year, at the No 22 station of the No 6 oil extraction plant, four village females suddenly came over the wall to distract the on-duty oil worker, while 8 other persons opened a valve of an oil well near the measuring station to steal oil. The on-duty worker realized what was happening, dashed out to close the valve, and was severely beaten. On one occasion when thieves were stealing electricity, the workers restored a power line that had been cut off, only to have the thieves connect up again; "You hook up, we cut off"—back and forth it goes. Some outlaws still obstruct and beat up law enforcement personnel. In the last 8 months alone, oil field public security guards have been surrounded and attacked 48 times during the course of their duties, 101 guards have been injured, 5 patrol vehicles and 4 motorcycles have been smashed, and 61 oil field production staff and workers have been beaten and injured on their jobs. Public security guards who have gone into the villages to issue summons have been mobbed.

The normal production at the oil field has been seriously hampered by theft of materials. Since 21 August, the No 6 oil extraction plant, Machang oil well, Chun-8 and Chun-9 stations located in Dongming County have repeatedly been plundered by crowds, facilities at eight wells were broken up, radio transmitters at stations smashed, and plugs on oil wells have been disengaged, causing seven oil fields to stop production for one month, cutting output by more than 2,000 tons. At 8 a.m. on 29 May at the No 23 station of the No 3 oil extraction plant, because villagers at Zhaozhuang village, Puyang County, Henan were stealing electricity, the station transformer blew out, the distributor panel burned, and 12 measuring stations were put out of service for 8 hours causing losses at the oil field that amounted to nearly 110,000 yuan.

Pillage by outlaws also has damaged the fields in the vicinity of the wells. While gathering information at the No 6 oil extraction plant, the reporters saw wells surounded by ditches and hollows that had been dug that caused adjacent land to be polluted. A comrade of the No 6 plant said that virtually no clean spots can be found around wells because of theft by outlaws. Some villages recklessly cut power and gas lines, often causing shortages and gas explosions that injure and kill people and livestock.

Deputy Chief of the Zhongyuan Prospecting Bureau, Zhang Yuren [7022 3205 0087], said that the theft of oil field materials must be stopped, and there must be mutual support and cooperation to put national interests in first place, and the interests of the whole must be considered. The oil field and local comrades, at this point, are fully aware of this. (editor's note: This is a very important point. Only with unanimous recognition, and keeping in step can this problem be solved) The following points should be further emphasized:

First, all levels of leadership should focus their attention on carrying out concrete measures. Oil fields are the backbone of China's industry, and strengthening internal administration should be initiated, staff and worker-s'units should be adjusted, and the local governments in the oil district, while building up the rural villages, must strengthen the education of the rural people on the legal system. (editor's note: at the same time, those who organize disobedience of the law and refuse to mend their ways should be investigated and sternly dealt with in order to improve the situation)

Next, there must be strict support of the law. Public security elements must firmly adhere to the law and prosecute criminal elements. Illegal and criminal activity cannot be tolerated.

Finally, oil field and local governments should combine forces, unify their direction, and begin by banning illegal acquisition and sale of grid power, investigating and dispensing with all irregularities, and thoroughly eradicating all outlets for stolen commodities.

Big Breakthrough in Prospecting in Xinjiang

926B0038A Urumqi XINJIANG RIBAO in Chinese 21 Nov 91 p 1

[Article by correspondents Yang Xiaobao [2799 1420 6283] and Zhang Wenye [1728 2429 2814]]

[Text] An oil and gas flow from the carboniferous system at the Lunnan-59 well announces once again a new major breakthrough in petroleum prospecting.

On 17 November the Lunnan-59 well, using strict well-finishing measurement procedures, installed two high-pressure oil and gas separators, two pipelines for the output, two 11.1 mm oil nozzles, and produced a steady daily output of 1.18 million cubic meters of natural gas and 98.8 cubic meters of oil, close to a daily output of over 1,200 tons per well, and a very steady well pressure. Experts say that the discovery of this well is another milestone that will bring even more oil and gas prospecting to Tarim. The Lunnan-59 well is a key exploratory well located on the eastern arm of the Jilake structure. Prior to this, the triassic system of the Jilake had structure repeatedly yielded up high-output oil and gas wells, turning out an oil and gas field that is ready to go. The Lunnan-59, on the fine quarts sandstone at the base of the carboniferous system, displays excellent signs of oil and gas, and after well completion tests, yielded high output, proving the carboniferous system beneath Jilake oil field has high-yield oil and gas strata. Proceeding eastward, after the Hetang well, another major find was made. According to seismic data, this sandstone stretches northeast and southeast, getting gradually thicker, and experts believe that this is possibly a major oil field.

Based on present preliminary seismic and well drilling data, it is postulated that this oil pool strata is inconsistent. This is the first discovery of this kind of oil pool at Tarim, which opens up a new territory, and has major implications for expanding oil and gas prospecting there.

The Lunnan-59 well project units, the Xinjiang Well Drilling Corporation's 60151 well drilling team, and the Huabei Test Corporation are following the ethic of "double new, double high" in their drilling and prospecting engineering. They work in close cooperation, use strict scientific methods, and have a thirst for oil and gas discovery. They are meticulous in design and construction, prompt with core samples and electronic logging, quick to detect oil and gas and well completion tests, and they have made exceptional contributions in this discovery of oil and gas.

Jiangsu Could Reap Big Benefits from Development of Southern Yellow Sea Oil Fields

926B0032 Beijing XIANDAIHUA [MODERNIZATION] in Chinese No 11, 23 Nov 91 pp 56-57

[Article by Jiangsu Provincial Science and Technology Association vice chairman and Nanjing University professor Wang Ying [3769 4481]: "Proposals for Developing Southern Yellow Sea Marine Petroleum"]

[Text] Jiangsu province is a large economically developed province as well as a maritime province. It has a coastline nearly 1,000 kilometers long, several river mouths, waterways, and harbors, over 6 million mu of beaches (one-fifth of China's total), and an offshore radiating sandbar covering 20,000 square kilometers. This is the only huge sandbar and deep waterway in China and a valuable shallow sea resource seldom seen in the world. The sea bottom of the southern Yellow Sea offshore from Jiangsu Province contains abundant marine petroleum resources. Development of these marine resources would spur further development of Jiangsu's economy, in particular an economic takeoff in northern Jiangsu. Here, I will provide several situations and proposals concerning the questions of developing Jiangsu's offshore marine petroleum and invigorating Jiangsu's economy.

I. Abundant Petroleum Resources

China has a vast offshore continental shelf and its development of marine petroleum is still young. Surveys and prospecting over the past 20-plus years have discovered six large sedimentary basins with excellent oil generation and accumulation conditions (the Bohai Basin, Southern Yellow Sea Basin, East China Sea Basin, South China Sea Zhu Jiang [Pearl River] Mouth Basin, Beibu Gulf Basin, and Yinggehai Basin) where more than 10 oil and gas fields have been discovered. In 1982, energy resource advisors from the United States estimated that China had 7 to 10.5 billion tons of extractable petroleum offshore, while the estimate for the interior of China was 4.2 to 10.0 billion tons. The general view in the world is that the marine oil fields on China's continental shelf are a crude oil treasurehouse of which there are few in the world.

The Southern Yellow Sea Basin is located offshore from Jiangsu and is an extension of the Subei [northern Jiangsu] oil field into the sea. The basin covers an area of 100,000 square kilometers. The Ministry of Geology and Ministry of Petroleum Industry have done a great deal of geophysical and exploratory drilling work in the southern Yellow Sea. This basin developed primarily during the early Tertiary Paleocene and Eocene periods, and its enormously thick sedimentary strata have excellent oil generation conditions. Oil and gas indications have already been found in lower Tertiary system and Paleozoic system strata, and there are also upper Paleozoic and lower Triassic system marine facies oil generation and accumulation strata. Many buried hills in the Southern Yellow Sea Basin also have excellent indications of anticline structures in the upper Paleozoic, so the scope for oil prospecting is very broad. According to United States estimates, the southern Yellow Sea has recoverable petroleum reserves of 220 million tons (low value), 570 million tons (middle value), and 2.16 billion tons (high value), second only to the East China Sea Basin in China. The Ministry of Petroleum Industry estimate is 290 million tons. This is a huge marine petroleum resource in China that is connected to the Subei Oil Field.

II. What Work Can Jiangsu Province Participate In To Develop Southern Yellow Sea Petroleum?

1. Marine petroleum development requires huge investments and advanced technology. In cooperative exploration and development between China and foreign countries, drilling, oil extraction, platforms, seabottom pipelines, and other projects required scientific information on marine hydrology, meteorology, seabottom dynamics, geomorphology, and sediments, engineering geology, earthquake dangers, underwater engineering, and other areas. Over the past few years, through reverse contractual responsibility from China to foreign businesses, we have already recovered $500 million in foreign exchange from the $2.2 billion invested by foreign countries and raised technical levels on our part during the work. China will spend several 10 billion yuan on exploration and development over the next several years. Jiangsu has many universities, research academies and institutes, and huge marine S&T forces. It should give serious consideration to participating in marine environment and geological research work to develop this marine petroleum. Sharing in this investment will produce enormous benefits for Jiangsu Province's technological and economic development.

2. Development and exploration of southern Yellow Sea petroleum will require large amounts of reserve supplies, maintenance of the berths for operating ships, supplies and repairs on all types of equipment, living and entertainment facilities for operating personnel from China and foreign countries, and so on. At present, the initial exploration base area is in Shanghai. When the time arrives for expanded exploration, extraction, and production, this rear-area continental base area will become a huge industrial city. Exploration and development of South China Sea petroleum has already brought prosperity to the Guangzhou and Zhanzhou base areas. The formerly barren suburbs of Zhanzhou have now become an emerging city as a result of the establishment of the Western South China Sea Petroleum Company base area. The Southern Yellow Sea Basin is offshore from Jiangsu and when there is large- scale exploration and development, it obviously would be unreasonable and extremely uneconomical for Shanghai to continue serving as a base area. Jiangsu should prepare to establish a "Southern Yellow Sea Petroleum Base Area" and get busy on selecting a site for the base area and do good preparatory work on harbors, roads, communications systems, and so on to create the conditions for diverting the oil and gas resources of the southern Yellow Sea onto the land in northern Jiangsu.

3. Marine petroleum development involves technically complex and technologically intensive modernized systems engineering. Jiangsu Province is economically developed and has a high value of industrial and agricultural output, but it also has a dense population and a shortage of energy resources which are restricting a further takeoff of its economy. Development of southern Yellow Sea oil and gas could provide local sources of some energy resources and spur the development of new

types of enterprises. The requirements of the marine petroleum and petrochemical industries will spur iron and steel, metallurgy, civil engineering, shipbuilding, machinery, transportation, and deep sea engineering as well as marine surveying and exploration, maritime rescue, environmental protection, maritime forecasting, and many other enterprises and technologies. This will change the industrial structure and configuration of communication in Jiangsu Province, promote the development of coastal harbors and cities, and spur a takeoff in the coastal economy of northern Jiangsu.

III. I Suggest Building Two Base Areas

Development of southern Yellow Sea petroleum is an excellent opportunity for promoting the economy of northern Jiangsu and it should not be viewed simply as an affair of state petroleum departments. It should be integrated with Jiangsu's economy and Jiangsu should actively participate in the development of southern Yellow Sea petroleum. I feel that the time has come to organize S&T forces in Jiangsu to conduct preparatory feasibility research on establishing a "Southern Yellow Sea Petroleum Base Area" and "Northern Jiangsu Coastal Oil and Gas Storage, Processing, and Petrochemical Base Area" on the coast of Jiangsu.

Deepwater harbors and rear area supplies (cities) will be decisive in establishing a marine petroleum exploration and development base area and an oil and gas storage, processing, and chemical industry base area. Based on my work over many years at Nanjing University, Lianyungang and Nantong are appropriate choices. Lianyungang's advantages are that it already has a harbor and a city to depend on. Its conditions are rather good and the only problem is its distance from the oil field. Nantong has two locations that could be selected. One is Yangkougang in Rudong County, where a 100,000-ton grade deepwater harbor could be built at Huangshayang, the biggest deepwater channel in the radiating sandbars. This is one of the deepwater harbor sites along the Chinese coast where the natural water depth could be used to build a large deepwater harbor, and it is an extremely hard-to-come-by deepwater resource. Nanjing University and Hehai University have cooperated over the past several years on much exploration and research work concerning this valuable deepwater resource and it has been debated by experts in China. Huangshayang in Rudong County is best suited to the development of a large petroleum harbor and there is a large area of barren beaches along the coast that are suitable for establishing a chemical industry base area and city. Another valuable area of water in Nantong is the Xiaomiao floodwater channel offshore from Ludong in Rudong County, where a 50,000 ton-grade deepwater harbor could be built. The Nanjing Academy of Water Conservancy Science has already done a great deal of research and discussion work. Thus, the Jiangsu coast has the conditions for bringing onshore, storing, and processing southern Yellow Sea oil and gas.

First Stage of Moxi Gas Field Completed

926B0049C Chengdu SICHUAN RIBAO in Chinese 3 Jan 92 p 1

[Article by Wang Nenggui [3760 5174 6311] and Huang Kaijin [7806 7030 6855]]

[Text] One of Sichuan's key construction projects, installation of the Moxi gas field's 500,000 cubic meter natural gas purification apparatus and associated construction at the Chuanzhong mining district was completed, checked, and accepted at the Chuanzhong mining istrict on 18 December 1991, marking completion of the first-phase of the construction of Moxi gas field and start-up of its operations.

The Moxi gas field's first-phase construction included the setting up of the natural gas purification installation, 276 kilometers of pipes for collecting and transporting the gas, 29 sets of wellhead installations, 8 gas collecting and transporting stations, 183 sets of collecting and transporting facilities, and the necessary power generating and communications facilities. For high- speed, high-quality, and high-level development of Moxi gas field, the technicians of the Sichuan Petroleum Design Academy swiftly completed the engineering designs; the Petroleum Construction Corporation dispatched experts to do the capital construction, lay pipes, and install facilities; engineering technicians of the Chuanzhong Mining District carefully organized the mining district staffs and workers, who in a concerted effort quickly installed the individual well installations, converted the internal piping, and set up communications lines; and the local government assisted throughout, assuring smooth operations. In February 1991, after the first-phase test runs, the daily amount of gas transported was 500,000 cubic meters. The natural gas purification installation, and the full-scale collection and transporting system went through a 10-month run, transported 135 million cubic meters of gas to the north circuit trunk line, and produced 2,130 tons of high quality sulphur.

The completion of Moxi gas field's first-phase construction will have an important impact on the imbalance of supply and demand for natural gas in Sichuan, guaranteeing construction of a new large gas operated chemical fertilizer factory and the development of Sichuan's economy.

Shanshan Field Has 500,000-Ton Production Capability

926B0038B Urumqi XINJIANG RIBAO in Chinese 22 Nov 91 p 1

[Article by reporters Jiang Yifeng [5592 0001 1496] and Fan Jinfei [3382 6930 2431]]

[Excerpt] On 20 November at 1050 Beijing time, the Dongfeng No 0728 diesel locomotive, pulling fully loaded tank cars carrying 1,620 tons of crude oil, slowly

departed the Shanshan oil depot, signalling genuine progress in the development of Turpan-Hami [Tu-Ha] petroleum prospecting and production capability.

After the key tasks in construction of the Shanshan oil field, the Shanshan oil depot, and the dedicated rail line were completed recently, and oil began flowing from the wells through an underground pipe network into individual collectors and on to a common terminal, and finally into tank cars for shipment. Today, the China Petroleum and Natural Gas Corporation is reporting that the target of achieving a 500,000-ton-per-year output capability at Tu-Ha has been met.

The Tu-Ha petroleum prospecting and development battlefield is a skirmish in the national petroleum industry's strategy of "steady in the east, develop in the west". More than 16,000 employees of 28 oil fields and enterprises, and 24 scientific research academies and institutes have converged on the 48,000-square-kilometer area within the Tu-Ha Basin. From September 1987 up to the present, a very impressive petroleum geological reserve has been proven at Tu-Ha, including the Yilahu, Shanshan, and Qiuling oil fields, and the Wenjisang, Wenxi, Qiudong, and Kekeya oil-bearing structures. In February of this year the Tu-Ha petroleum prospecting and development field headquarters was established, and national investments of 1.4 billion yuan were made, accelerating the pace of prospecting and development. The headquarters focused the contest on construction of the Shanshan oil field development and testing areas, and production capability, and it went after prospecting and development with persistence and determination and obtained equal results. To date, Shanshan oil field has produced 170,000 tons of crude oil, and its annual output will reach 200,000 tons. The drill-prospecting success rate was at least 50 percent better than the anticipated success rate, and some were 80 percent. Tu-Ha oil field's expenditures for proving reserves were only one-half of the national average, gaining obvious social and economic advantages. At the same time, Tu-Ha oil field well drilling teams were even in performance throughout the whole area, and from start to finish three national high-tech records and six new field records were set. The 16 drilling teams in the area achieved a total drilling footage exceeding 10,000 meters, of which seven teams were over 15,000 meters, and three teams broke the 20,000 meter barrier. By the end of October, 127 drillings had been started and 125 had been completed in the oil field, and the oil well start-up rate reached 46 wells. It thus can be foreseen that in the Eighth 5-Year Plan, Tu-Ha oil field will impress the whole country with its high degree of all-round capability, its automated administrative environment exaltedd in the west, and it will make a creditable contribution to socialist construction and the Xinjiang people's economic development. [passage omitted]

Qinshan Joins Grid

926B0043A Shanghai JIEFANG RIBAO in Chinese 18 Dec 91 p 1

[Excerpts] On 15 December 1991 at 12:15 a.m., China's first nuclear power plant—Qinshan nuclear power plant—delivered power into the grid for the first time.

When operators in the quiet main control room of the Qinshan Nuclear Power Station turned on the black synchronous switch and the power output indicator panel jumped from 0 to 15 MW, electricity generated by nuclear power flowed for the first time into the East China Power Grid. [passage omitted]

On 8 February 1970, Premier Zhou instructed that nuclear power plant research be started in Shanghai. In November 1981, the Qinshan nuclear power plant was designated as a key national engineering project. In March 1985, concrete was poured for the reactor building, marking the start of work on China's first nuclear power station. The Qinshan nuclear power plant is located on Hangzhou Bay in Haiyan County and occupies an area of 166.5 acres. Total project investment is 1.2 billion yuan. Qinshan's 300MW unit is a pressurized water reactor with more mature and sophisticated level of technology. Only a few countries in the world today can design, develop and build this kind of reactor and plant.

The completion and inauguration of Qinshan is an important breakthrough in the peaceful application of nuclear power by China's nuclear industry. The technology for nuclear power is an integrated technology in the realm of high-tech industry. Qinshan nuclear power plant was jointly designed by six government units, including the Shanghai Nuclear Engineering Research and Design Institute and the East China Power Design Institute of the Ministry of Energy. Over 600 manufacturers were involved including the Shanghai Boiler Works, the Shanghai Turbine Machinery Factory, and the Shanghai No. 1 Machinery Factory. [passage omitted]

The activated carbon fibers designed specifically for use in the air purification equipment were jointly designed and developed by the Shanghai Textile Research Institute, Fudan University, and the Shanghai Nuclear Engineering Research and Design Institute. Five hundred eighty five factories all over the nation undertook the manufacture of 28,000 pieces of equipment. Gas turbines, generators, steam-generators, components of the reactor pile, nuclear fuel parts and other key equipment are all manufactured in China. The successful completion of Qinshan demonstrates that China can organize its own team of technical professionals in the design, manufacture and development of nuclear power plants laying the foundation for future development of nuclear power. This is significant to the future construction of nuclear power plants, the evaluation, digestion of imported technology and the future development of related industries.

After the full-capacity operation, Qinshan will be able to generate annually 1.5 billion kilowatt-hours of nuclear-powered electricity into the East China Power Grid (covering Zhejiang, Jiangsu, and Anhui provinces and the City of Shanghai). To some extent, this will relieve the power crunch in China's economically most developed and yet most power-thirsty region.

Sijiao Island: Nation's Largest Wind-Powered Electricity Test Base

926B0035A Beijing RENMIN RIBAO in Chinese 11 Nov 91 p 8

[Article by Ding Zhicai [0002 5267 4965]]

[Excerpt] China's largest test base for medium-sized wind-powered electric generators just recently built, has, along with local small thermoelectric units, joined the grid to supply electricity.

Sijiao Island is the largest island in Zhejiang Province's Shengsi Archipelago, where, since the FD-16 model unit was installed in 1977, national and local governments have kept a close watch on the development and utilization of wind energy. After more than 10 years of hard work, Sijiao Island has become a wind-powered electric power generation research base for Chinese-made medium-sized wind power equipment and Sino-German cooperation in new energy technologies. The total installed capacity of the wind-powered electric generator test base is 462 kW, and under normal wind conditions it can produce 1.22 million kWh annually. It has joined the grid along with local small thermoelectric units, its wind power making up 8.87 percent of the 12.50 million kWh generated annually on Sijiao Island. China's installed capacity for wind generated electricity is on a par with California's which leads the U.S. in development and use of wind energy. By the year 2000, wind power will make up 10 percent of the electric power capacity of California, so it is evident that the development and utilization of wind energy on Sijiao Island has joined the world's advanced ranks. [passage omitted]

Use of Solar Energy in Gansu Outlined

926B0035B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 22 Nov 91 p 1

[Article by reporter Zhu Weiwei [2612 5898 5898]]

[Excerpts] [passage omitted] In Gansu's vast agricultural and pastoral areas, coal, electricity, and fuels are lacking, but the days are long, there is much sunlight, and the atmosphere is clear. For this reason Gansu Province is making use of the sun as an important new energy source to alleviate energy shortages in agriculture and to protect the ground cover. The provincial government and provincial planning committee have set up a leadership organization, and for years the provincial science committee has supported a comprehensive system for solar energy technology development projects, sales, dissemination, and services.

The Gansu Natural Energy Institute specializes in applied solar energy research, and is among the first ranks in the country for developing solar stoves, solar houses, solar water heaters, and photoelectronics items. In the Seventh 5-Year Plan, this institute completed 80 research projects, 23 of which received provincial and ministerial awards. With combined local departments and national support, it built the Yuzhong solar energy test base, the country's largest, that has instruments and facilities, and an advanced test laboratory for solar energy and photoelectronics research. The solar stove it developed has been exported to 18 Asian countries. It is now involved in the U.N. development planning office's "West China photoelectronics development" project, and has trained technical administrative talent for 11 African countries. In addition, Gansu has three other research institutes, three high schools, and four design academies whose achievements in the use of solar energy have spread into Xizang, Qinghai, Nei Monggol, Ningxia, and Xinjiang.

Gansu has 17 fair-sized factories with solar energy production facilities that have a fixed investment of 60 million yuan, and a capability to produce 3,000 solar stoves a year. Double-pane sealed steel windows, rubber sealing strips, sealing rubber, insulated window blinds, heat recycling fans, auxiliary energy devices and other materials used for solar heating have been developed. By September of this year, 65,000 solar stoves were disseminated throughout the province, thousands of agricultural and pastoral households are living in "solar houses", and as many as a thousand agricultural and pastoral non-electrified households have electric lighting and TV. [passage omitted]

In June this year, the Gansu Provincial Government passed the "Solar Energy Product Commercialization" regulation. In the Eighth 5-Year Plan, Gansu will invest nearly 100 million yuan to further organize present research, production, and dissemination forces, and develop a solar energy technology commercialization system. By the end of the Eighth 5-Year Plan, a solar energy industry with a planned annual output of about 276 million yuan will be in place on the old silk road.